CANADA / NEWFOUNDLAND

CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

OVERVIEW OF THE SMALL SCALE ENERGY DEMONSTRATION PROGRAM

CR 85-100

OVERVIEW OF THE SMALL SCALE ENERGY DEMONSTRATION PROGRAM

Prepared for:

Energy Branch
Department of Mines and Energy
Government of Newfoundland and Labrador
P. O. Box 4750
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CANADA/NEWFOUNDLAND CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION PROGRAM

Because of the sharp increases in the cost of oil, natural gas and electricity within the past 15 years, the search is on for economical sources of energy. Affordable energy, now and in the future, concerns everyone.

In June 1979, to help meet this demand for conservation and alternative sources of energy, the Government of Canada and the Government of Newfoundland and Labrador signed the Conservation and Renewable Energy Demonstration Agreement (CREDA).

The objectives of this $11,250,000 cost-shared program (Federal 80%, Provincial 20%) included the following:

- to develop and demonstrate promising new technologies which use renewable energy resources;
- to develop and demonstrate new and efficient technologies which conserve energy;
- to create employment in new and existing energy related industries;
- to inform the public of the economical use of new technologies as they apply to the energy resources of Newfoundland and Labrador.

The CREDA program ended March 31, 1985. For more information on this and other energy projects funded under the Canada/Newfoundland CREDA program contact:

Information Section
Energy Branch
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
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(709) 576-2411

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Conservation and Renewable
Energy Office
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PROGRAMME CANADA/TERRE-NEUVE DE DÉMONSTRATION DES ÉCONOMIES D'ÉNERGIE ET DES ÉNERGIES RENOUVELABLES

La montée en flèche du coût du pétrole au cours des 15 dernières années, du gaz naturel et de l'électricité a rendu nécessaire la recherche de sources d'énergie à bon prix. La question de l'énergie à coût abordable, pour aujourd'hui et les années à venir, touche tous les Canadiens.

Pour aider à répondre aux besoins en matière d'économies d'énergie et d'énergies renouvelables, le gouvernement du Canada et le gouvernement de Terre-Neuve et du Labrador ont ratifié en 1979 au Accord de démonstration des économies d'énergie et des énergies renouvelables (ADEEER).

Ce programme a été doté d'un budget de 11,25 millions de dollars, et le gouvernement du Canada et celui de la province s'en partageant les coûts dans une proportion de 80% et 20% respectivement. Quelques-uns de ses objectifs étaient:

—La mise au point et la démonstration de nouvelles techniques prometteuses faisant appel aux énergies renouvelables;

—La mise au point et la démonstration de nouvelles techniques efficaces d'économie d'énergie;

—La création d'emplois dans des entreprises nouvelles ou existantes oeuvrant dans le domaine de l'énergie;

—Faire connaître au public les avantages économiques de ces nouvelles techniques telles qu'applicables aux ressources énergétiques de Terre-Neuve et du Labrador.

Le programme ADEEER prendra fin le 31 mars 1985. On peut obtenir plus de renseignements sur le programme ou sur les sujets qui ont fait l'objet d'une aide financière en vertu de l'Accord Canada — Terre-Neuve sur les économies d'énergie et les énergies renouvelables en communiquant avec:

Section de l'information
Direction de l'énergie
Ministère des Mines et de l'Énergie
C. P. 4750
St-Jean, Terre-Neuve
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Energie, Mines et
Ressources Canada
Bureau de la Conservation
et des Énergies Renouvelables
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St. John's, Terre Neuve
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Disclaimer

"This publication was prepared under the Canada-Newfoundland Conservation and Renewable Energy Demonstration Agreement which was co-funded by Energy, Mines and Resources Canada and the Newfoundland and Labrador Department of Mines and Energy. Distribution of the report by the funding departments does not necessarily signify that the contents reflect the views and policies of these departments. Any mention of trade names or commercial products does not constitute recommendation or endorsement for use."

ABSTRACT
Overview of the Small Scale Energy Demonstration Program

The purpose of the Small Scale Energy Demonstration Program was to promote the use of alternative energy technologies and innovative energy conserving measures for small scale projects across Newfoundland and Labrador. The intent of these projects was to reduce the total energy consumption of the building or unit for which it was intended. Although each project was carefully considered with the economic and technical feasibilities being thoroughly reviewed, the final results of the individual projects had varying degrees of success. A total of forty projects was demonstrated. The average payback period was from four to seven years. Exceptionally good projects had payback periods of one to three years while exceptionally poor projects had payback periods of twenty to eighty-four years.

RÉSUMÉ
Programme de Démonstration de Projets Énergétiques de Petite Envergure

Ce programme avait pour but de promouvoir l'utilisation de techniques relatives aux économies d'énergie et aux énergies de remplacement pour de petits projets à Terre-Neuve et au Labrador. Ces projets visaient à réduire la consommation énergétique totale de l'immeuble ou du logement visés. Malgré le soin apporté à évaluer chaque projet, en faisant appel, entre autres, à de sérieuses études de faisabilité technique et économique, le taux de réussite a varié considérablement d'un projet à l'autre. Au total, 40 projets ont été réalisés. En moyenne, la période de recouvrement de l'investissement s'est située entre quatre et sept ans. Cette période de recouvrement a varié de un à trois ans pour les très bons projets et de vingt à quatre-vingt-quatre ans pour les projets exceptionnellement mauvais.

ACKNOWLEDGEMENTS

Provincial Consultants Limited would like to thank the following people for their contribution to making this report possible: Mr. P. Graham, Mr. J. Drover, Mr. A. Winsor, Mr. W. Kearley and last but not least Mrs. D. Hohoff.

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1.0 EXECUTIVE SUMMARY

The purpose of the Small Scale Demonstration Program was to demonstrate the potential usefulness of new small scale (designed for a single household or small business) alternative and energy conservation technologies in the province.

The program provided grants to project owners of up to 66% of system costs as well as funds for information and technology transfer. A total of forty projects in six broad grouping of technologies were demonstrated. These were (1) Heat Pumps, (2) Alternative Energy (wind, photovoltaics, micro-hydro, heat storage fireplace, solar panels), (3) Waste Energy (waste oil burners, fish oil burners, chicken litter burners, one waste wood burner), (4) Energy Efficient Construction, (5) Heat Recovery, and (6) Energy Management Control.

Results of the Program found that the most cost effective technologies were (1) Heat Pumps, (2) Solar Swimming Pool Heaters, (3) all the Waste Fuel projects (fish oil, waste wood, waste engine oil, chicken litter waste), (4) most of the Heat Recovery projects, (5) Night Setback Thermostats, (6) Demand Controllers and (7) Pool Blankets. These projects all paid for themselves in less than 5 years. The least cost effective projects were the Wind Energy systems for individual residences with paybacks as high as eighty five years.

1.0 Executive Summary (Cont'd)

Although program results were generally favourable with a majority of successful projects, it is not surprising that there were some failures. The funding agencies (EMR & M & E) realized at the outset that the technical and managerial capability of some project proponents would be limited and a 100% success rate could not be expected. Governments role did not go much beyond a careful initial review of proposals prior to grant approval, a couple of site inspections, and monitoring and reporting of overall results. The responsibility for installing and operating equipment was left to the proponents themselves.

2.0 BACKGROUND

In 1979 the Canada/Newfoundland Conservation and Renewable Energy Demonstration Program (CREDA) was established with three main objectives. These were:

(1) The development and demonstration of promising new technologies which use renewable energy resources, conserve energy, or make its use more efficient,

(2) To create employment in new or existing industries,

(3) To develop broad public awareness of the potential of renewable energy and conservation technologies.

The funding for this project was $11,250,000 with the Federal Department of Energy Mines & Resources providing $9,000,000 and the Newfoundland Department of Mines and Energy providing $2,250,000.

2.0 BACKGROUND (Cont'd)

The Small Scale Energy Demonstration Program was established with a total budget of $308,500. Of this budget, $62,500 was allocated for information transfer and $46,000 for administration and program implementation. The remaining $200,000 provided and average of 66% of the total project funding for $300,000 worth of project costs.

From 1981 to 1982 the program was administered by the Energy Branch of the Department of Mines and Energy. A project management committee reviewed and evaluated the 80 or so project applications submitted by residents of Newfoundland and Labrador. Under this system, 19 projects were approved with funding totalling $100,000.

In 1983 a different approach was taken to evaluate project proposals from the private sector. A request for proposal was solicited by the Newfoundland Department of Mines and Energy for the project administration by a consultant. Provincial Consultants Ltd. was awarded the contract for the administration and the technical evaluation of each of these proposals from the private sector.

3.0 TECHNOLOGY DESCRIPTIONS

Under the Small Scale Energy Demonstration Program there were two (2) main categories of projects with six (6) different types of technologies being demonstrated. This part of the report has been divided into two (2) sections. Section 4.0 deals with "Renewable Energy" and has been further divided into 3 subsections (1) Heat Pumps, (2) Alternative Energy, and (3) Fuel From Waste. Section 5.0 deals with "Energy Conservation" and has also been further divided into 3 subsections, (1) Energy Efficient Construction, (2) Energy Management and Controls, and (3) Heat Recovery. All of the different types of projects within these 6 technologies will be described in the following subsections.

4.0 RENEWABLE RESOURCES INTRODUCTION

Renewable resources technologies tap a source of renewable energy and use it to provide heat or electricity. The sun and the Earth's geothermal energy, produced by radioactive decay, have been producing energy for billions of years. The results are many forms of naturally occuring renewable energy such as warm air and warm ground water, wood, biomass, and many others.

4.1 HEAT PUMPS

4.1.1 Description

The heat pump is a device which is used to transfer heat from a source, via a transfer medium, to some type of heat sink.

Because their heat source is renewable such as the sun warmed air or the geothermally warmed ground or ground water, heat pumps are considered to be a device which taps a renewable source of energy.

The operation of a heat pump can be compared to a refrigerator operating in reverse. Heat is removed from the source by evaporating the refrigerant and transfering the heat to a heat sink via a condensing refrigerant. As long as the air temperature is above -15°C and the heat pump has defrost control or the ground water temperatures are above freezing, the heat pump will effectively transfer heat energy from these sources.

4.1.1 Description (Cont'd)

Although heat pumps do not reduce the total energy consumption of the house, they do cut back on the fuel or electrical consumption. A heat pump does not actually produce heat, it transfers heat from a source to a sink. The co-efficient of performance is a measure of the ratio of energy transfered versus the amount of energy consumed by the heat pump in transfering that energy. Heat pumps are energy efficient devices, transfering two to three units of output heat energy for every one unit of input energy.

4.1.2 Program Applications

Under the Small Scale Energy Demonstration Program there were three (3) types of heat pumps demonstrated. These three types were air-to-air, air-to-water, and water-to-air. Their operation is quite simple and efficient, although the capital costs are fairly high. Project costs range from $1,700 to $6,300 with payback periods of 4.5 years to 8.5 years.

There were seven heat pumps installed under the Small Scale Energy Demonstration Program all of which were used in domestic applications. They were broken down into two types of applications for heat pump use. One type was used to heat domestic hot water while the other type was for space heating. Additional data for this report was provided by Mr. David Thompson, P. Eng., who has installed an air-to-water heat pump. Table 1 (Page 12) shows a list of the proponents, type of heat pump installed, project costs, payback periods and the application of each heat pump.

Energy, Mines and Resources Canada Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Air-to-air Heat Pump
C. J. O'Driscoll

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
50 Walsh Road
Kelligrews

Project Manager:
C. J. O'Driscoll

Date:
August, 1985

Project Number:
03:04:22(2):49

Status:
Completed

Technology:
Conservation
(Heat Pumps)

Sector:
Residential

Province:
Newfoundland

Purpose:

To demonstrate the energy saving potential of an air to air heat pump in new housing construction.

Description:

An air to air heat pump complete with new ductwork was installed in new 120 m² house. The heat pump takes heat from the outdoor air and transfers it to the indoor air distribution system for space heating.

Contributors:

C. J. O'Driscoll	$3,955
Canada/Newfoundland	$2,370
Total	$6,325

Demonstrated Benefits/Savings:

This design reduced the electrical consumption for heating purposes. Savings are approximately 30% or 10,000 kWh per year.

Information Contact:

C. J. O'Driscoll
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Phone: (709) 834-8801

or

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Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

Indoor coil unit.

SMALL SCALE PROJECT

AIR TO AIR HEAT PUMP

Economic Analysis:

Project Costs	
Capital	$3,480
Installation	$2,445
Total Installed	$5,925
Monitoring & Technology Transfer	$ 400
Total Demonstration Cost	$6,325
Operating Costs	
Pre-Installation	$2,000
Post-Installation	$1,400
Net Savings	$ 600
Simmple Payback Period	9.9 years

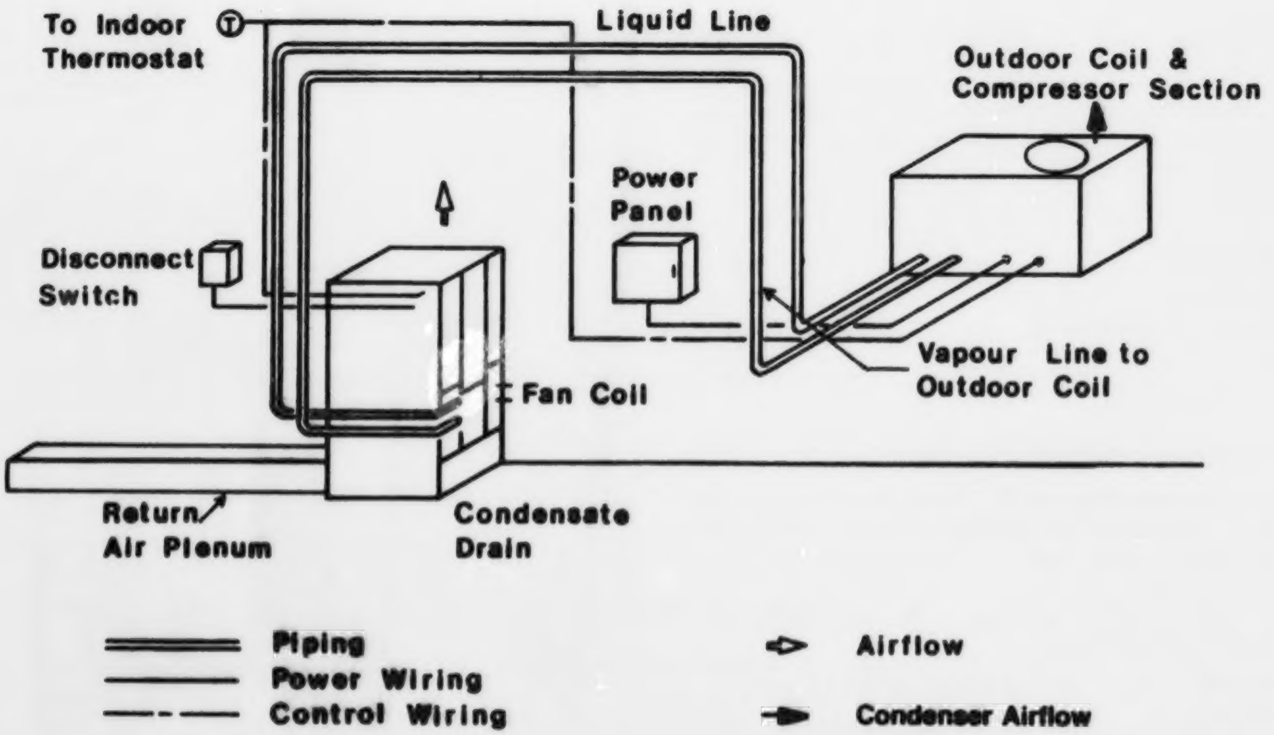
Monitoring Evaluation:

The proponent has installed an indoor/outdoor thermometer, and running hour meter to log operating temperatures and on time of the heat pump for the first year of occupancy.

Technical Details/Specifications:

The York split system heat pump has a nominal output of 7.7 kW, and at 4.5°C supplies 2.7 kW for each 1kW input. This unit is complete with electric duct heaters, night setback thermostats and a blower with ductwork. The York heat pump is in two units; (1) a condenser and (2) an outdoor coil and compressor section.

Schematic Diagram of Air to Air Heat Pump


To Indoor Thermostat
Ⓣ
Liquid Line
Outdoor Coil & Compressor Section
Power Panel
Disconnect Switch
Fan Coil
Vapour Line to Outdoor Coil
Return Air Plenum
Condensate Drain
Piping
Power Wiring
Control Wiring
Airflow
Condenser Airflow

Energy, Mines and Resources Canada   Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Air-to-air Heat Pump
F. M. Stanley, Sr.

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Kilbride

Project Manager:
F. M. Stanley, Sr.
Kilbride

Date:
March, 1985

Project Number:
03:04:22:28

Status:
Complete

Technology:
Heat Pump

Sector:
Residential

Province:
Newfoundland & Labrador

Purpose:

To demonstrate the energy conserving potential, reliability and economic viability of using air-to-air heat pumps in Newfoundland.

Description:

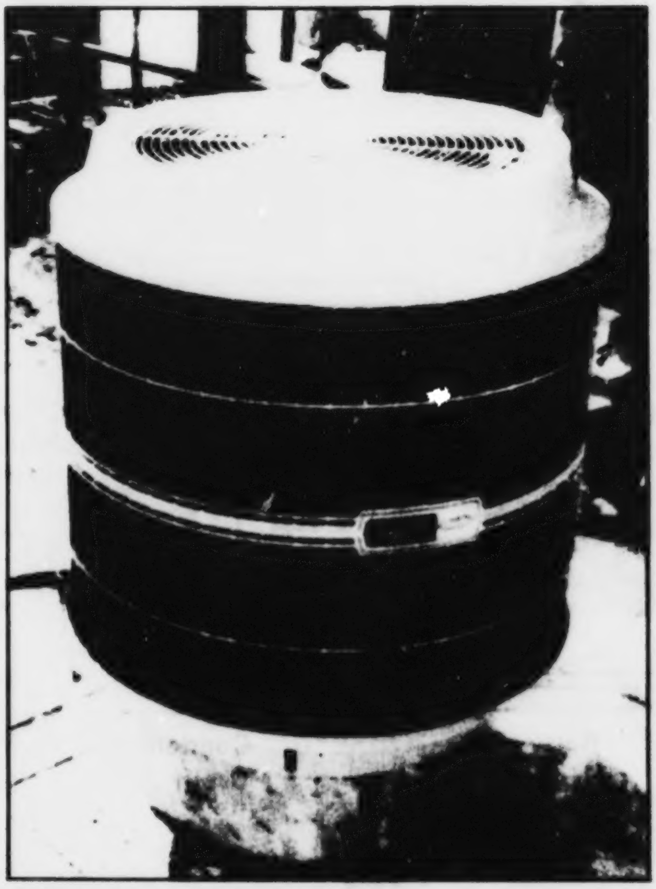
An air-to-air heat pump has been installed in a 126 m^2 residence in Kilbride. The heat pump takes heat from the outside air and transfers it inside, where it is distributed through the home's heating system.

Contributors:

F. M. Stanley, Sr.	$1,712
Canada/Newfoundland	$2,013
Total	$3,725

Demonstrated Benefits/Savings:

Using both electricity and wood fuel during the 1980-81 heating season, the total energy bill was $1,030 for 21,250 kWh (77GJ). With the installation of the heat pump in 1981 fuel costs for the 1981-82 heating season amounted to $475, a saving of 54 per cent over the previous season. The unit has a coefficient of performance (C.O.P.) equal to 2.5 i.e. for each unit of electricity used 2.5 units of heat are delivered.



Outdoor section of air-to-air heat pump.

Information Contact:

F. M. Stanley, Sr.
4 Dorcey's Lane
Kilbride, Newfoundland
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(709) 368-9029

or

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Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland, A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

AIR-TO-AIR HEAT PUMP

Economic Analysis:

Project Costs

Capital	$2,850
Installation	$ 575
Total installed cost	$3,425
Monitoring and technology transfer	$ 300
Total Demonstration Cost	$3,725

Operating Costs

Pre-demonstration annual fuel cost	$1,030
Post-demonstration annual fuel cost	$ 475
Net annual fuel savings	$ 555
Simple Payback Period:	6 years

Monitoring Evaluation:

The proponent is maintaining a daily log of indoor/outdoor temperatures, and meter readings. The energy consumed by the heat pump is being logged by use of a running time meter to determine the cost of operation per day.

Technical Details/Specifications:

The Carrier III heat pump system is in three parts:

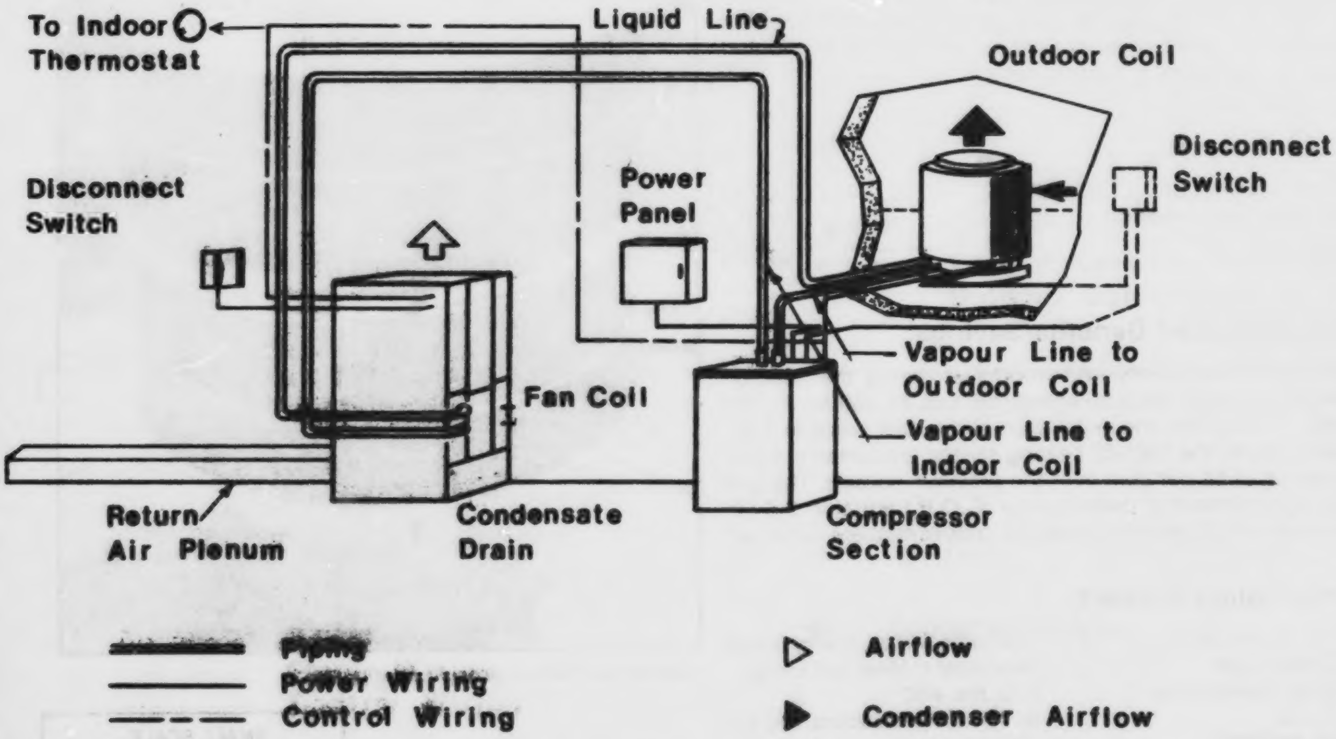
(a) A compression control unit which contains the compressor and simplified control system,

(b) An outdoor section which contains the circular coil, fan and meter and junction box,

(c) An indoor section which contains single point electrical connections with factory mounted controls. The cabinet is insulated to reduce noise. A multi-speed fan provides optimum performance.

The unit is capable of a 9.38 kW output at 8°C and has a C.O.P. of 2.5.

Schematic Diagram of Air-to-air Heat Pump System.


To Indoor Thermostat
Liquid Line
Outdoor Coil
Disconnect Switch
Power Panel
Disconnect Switch
Fan Coil
Vapour Line to Outdoor Coil
Vapour Line to Indoor Coil
Return Air Plenum
Condensate Drain
Compressor Section
Piping
Power Wiring
Control Wiring
Airflow
Condenser Airflow

Energy, Mines and Resources Canada

Energie, Mines et Ressources Canada

Mines & Energy
Government of Newfoundland
& Labrador

Air-to-water Heat Pump

Lawrence Cashin

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
10 Randell Place
St. John's

Project Manager:
Lawrence Cashin

Date:
August 1985

Project Number:
03:04:22(2):50

Status:
Complete

Technology:
Renewable energy
(Heat pumps)

Sector:
Residential

Province:
Newfoundland

Purpose:

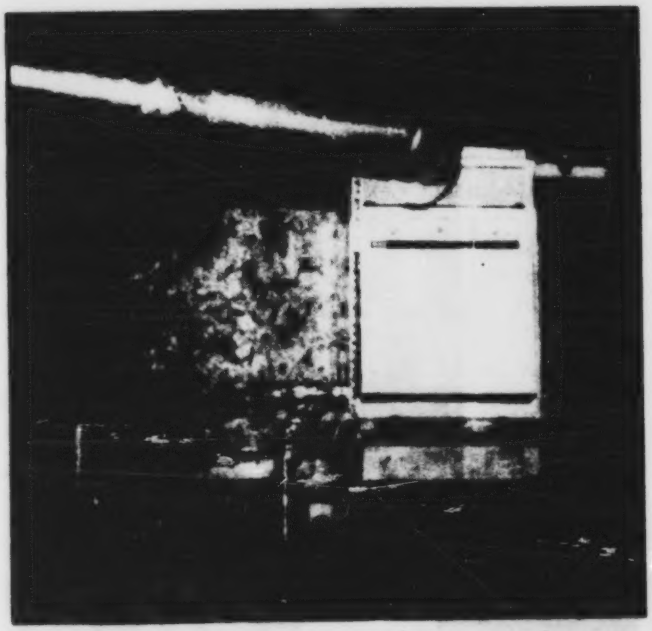
To demonstrate the recovery of waste heat in a basement furnace room.

Description:

An air-to-water heat pump was installed in the basement. Heat from the room is used to preheat the domestic hot water supply.

Contributors:

Canada/Newfoundland	$1,228
Lawrence Cashin	$ 580
Total	$1,808



Feeders heat pump installation.

Demonstrated Benefits/Savings:

The previous domestic hot water electricity bills were $400 per year. A saving of $80 per year, or 20% was realized after the heat pump had been installed.

Information Contact:

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or

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Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

AIR-TO-WATER HEAT PUMP

Economic Analysis:

Project Costs	
Capital	$1,508
Installation	$ 200
Total Installed Cost	$1,708
Monitoring & Technology Transfer	$ 100
Total Demonstration Cost	$1,808

Operating Costs	
Pre-Installation Costs	$ 400
Post-Installation Costs	$ 320
Net Savings	80
Simple Payback Period	21.4 years

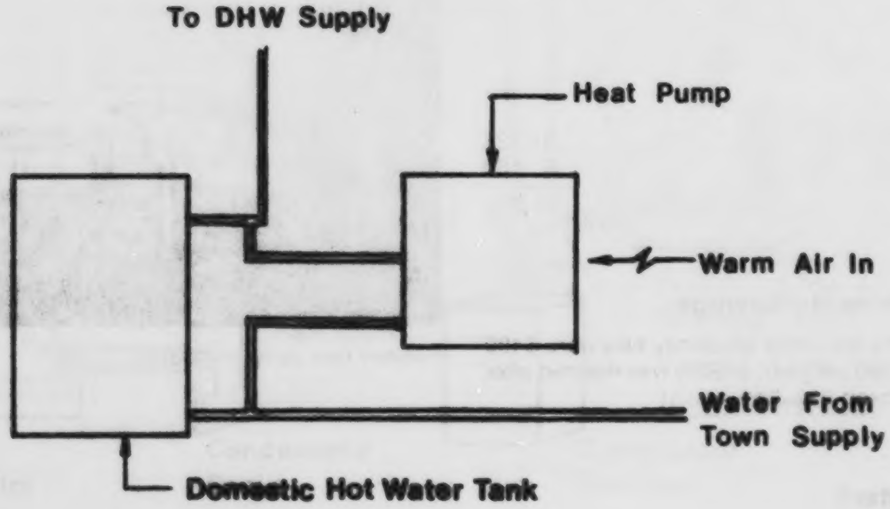
Monitoring/Evaluation:

Heating and electricity bills for a 12 month period after installation were compared with those for a similar period before installation to calculate energy savings. Comparisons were made on a "normalized" basis to allow for differences in heating requirements from one year to another. The recovered heat would have ordinarily helped to heat the rest of the house. The introduction of the heat pump has resulted in an increase in the heating oil consumption while the electricity consumption has dropped. Therefore, the actual savings from the heat pump is much lower than anticipated due to the extra oil heating cost.

Technical Details/Specifications:

The Feeders heat pump is a 115 VAC, 1305 Watt unit with hot water recovery rate of 310 L per hour. The unit weighs 67.5 kg. It is installed in the basement and uses waste heat from the furnace to supplement heating for the domestic hot water system.

Schematic Diagram of Air-to-Water Heat Pump



Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Air-to-air Heat Pump

Adrian Bonia

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Brown's Lane
Torbay

Project Manager:
Adrian Bonia

Date:
August 1985

Project Number:
03:04:22:(2):47

Status:
Completed

Technology:
Renewable energy
(heat pumps)

Sector:
Residential

Province:
Newfoundland

Purpose:

To demonstrate the energy saving potential of an air to air heat pump retrofitted in a typical electrically heated bungalow.

Description:

An air to air heat pump complete with new ductwork was installed in an existing house. The heat pump has been used to heat the house, supplemented with the existing electric baseboard heaters and a woodstove.

Contributors:

A. Bonia	$1,957
Canada/Newfoundland	$2,267
Total	$4,224

Demonstrated Benefits/Savings:

This design reduces electrical consumption for heating purposes; savings are projected to be approximately 33% or 10,300 kWh.

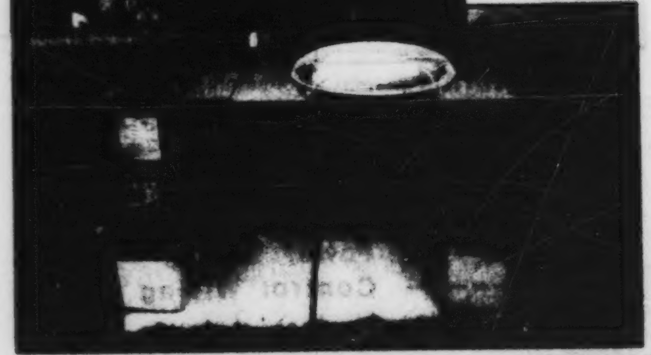
Information Contact:

A. Bonia
P. O. Box 304
Torbay, Newfoundland
A0A 3Z0
Phone: (709) 437-6184

or

Information Section
Energy Branch
Dept. of Mines & Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

Indoor coil unit.



Outdoor coil & compressor unit.

SMALL SCALE PROJECT

AIR TO AIR HEAT PUMP

Economic Analysis:

Project Costs	
Capital	$2,614
Installation	$1,300
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$4,224
Operating Costs	
Pre-Installation	$1,500
Post-Installation	$1,040
Net Savings	$ 460
Simple Payback Period	8.5 years

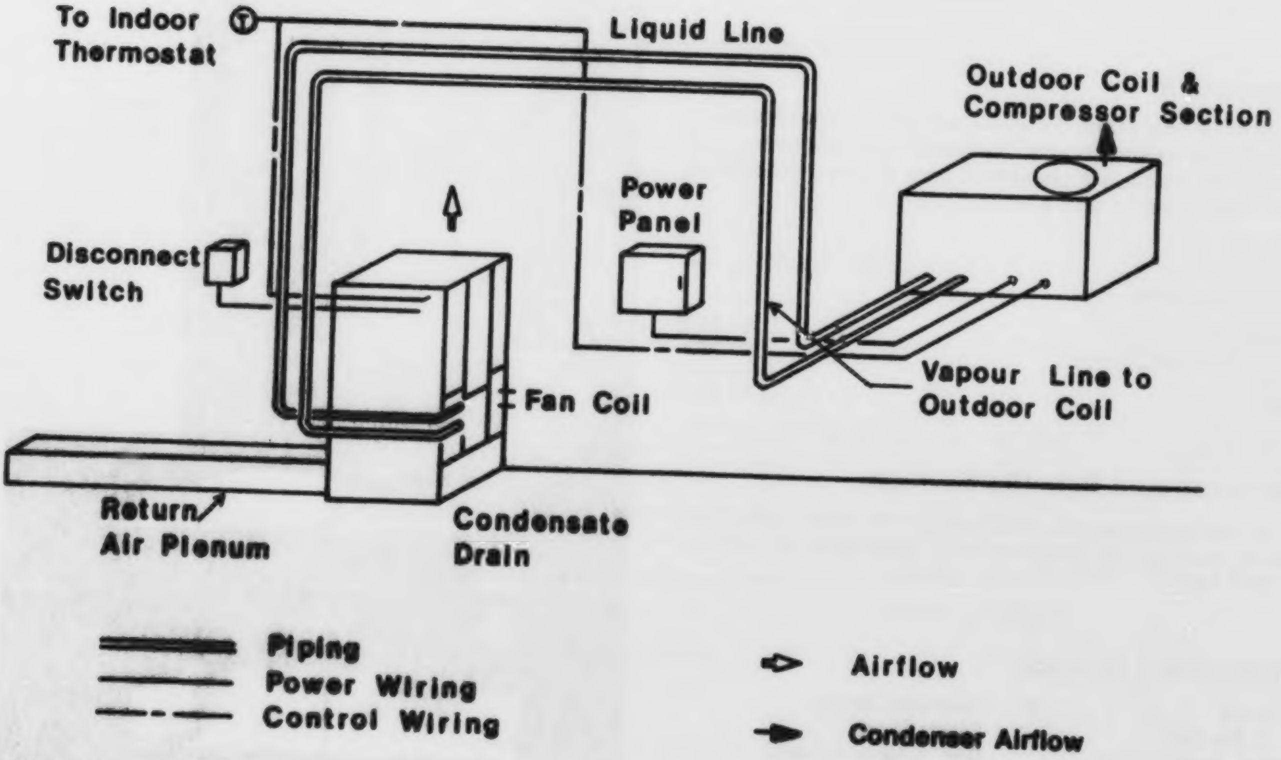
Monitoring/Evaluation:

An indoor/outdoor thermometer and a running hour meter were installed to log temperatures and on time of the heat pump for the first year of use.

Technical Details/Specifications:

The York split system heat pump installed has a heating capacity of 7.3 kW and puts out 2.8 kW per kW input (COP = 2.8) at 8.3° C. This unit is complete with electric duct heaters, night setback thermostats, and a blower with ductwork. The York heat pump is in two units: (1) a condensor, and (2) an outdoor coil and compressor section.

Schematic Diagram of Air to Air Heat Pump


To Indoor Thermostat
Liquid Line
Outdoor Coil & Compressor Section
Power Panel
Disconnect Switch
Fan Coil
Vapour Line to Outdoor Coil
Return Air Plenum
Condensate Drain
Piping
Power Wiring
Control Wiring
Airflow
Condenser Airflow

Energy, Mines and Resources Canada

Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Air-to-air Heat Pump
Spencer Winters

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

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Project Location:
Three Island Pond

Project Manager:
Spencer Winters
Torbay

Date:
March, 1985

Project Number:
03-04-22(2):45

Status:
Complete

Technology:
Heat Pump

Sector:
Residential

Province:
Newfoundland & Labrador

Purpose:

To demonstrate the energy saving potential of an air-to-air heat pump retrofitted in a typical electrically heated bungalow.

Description:

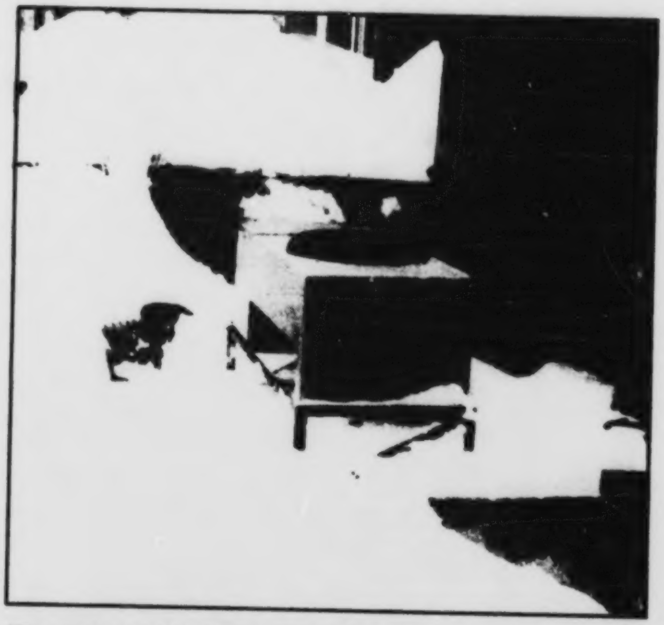
An air-to-air heat pump complete with new ductwork was installed in an existing 350 m² (3800 sq. ft.) house. The unit will remove heat from outside air and transfer it inside to heat the home.

Contributors:

Spencer Winters	$3,890
Canada/Newfoundland	$2,616
Total	$6,506

Demonstrated Benefits/Savings:

This project has reduced electrical consumption for heating purposes by approximately 55%.



The outdoor unit of the air-to-air Heat Pump.

Information Contact:

Spencer Winters
Winters Graham Agencies
P. O. Box 692
Torbay, Newfoundland
A0A 3Z0
(709) 722-4942

or

Information Service, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

AIR-TO-AIR HEAT PUMP

Economic Analysis:

Project Costs

Capital	$5,272
Installation	$1,119
Total Installed Cost	$6,391
Monitoring & Technology Transfer	$ 115
Total Demonstration Cost	$6,506

Operating Costs

(Based on Pre-demonstration heating conditions)

Pre Demonstration	$1,755
Post Demonstration	$ 783
Net Savings	$ 972
Simple Payback Period:	6.6 yrs.

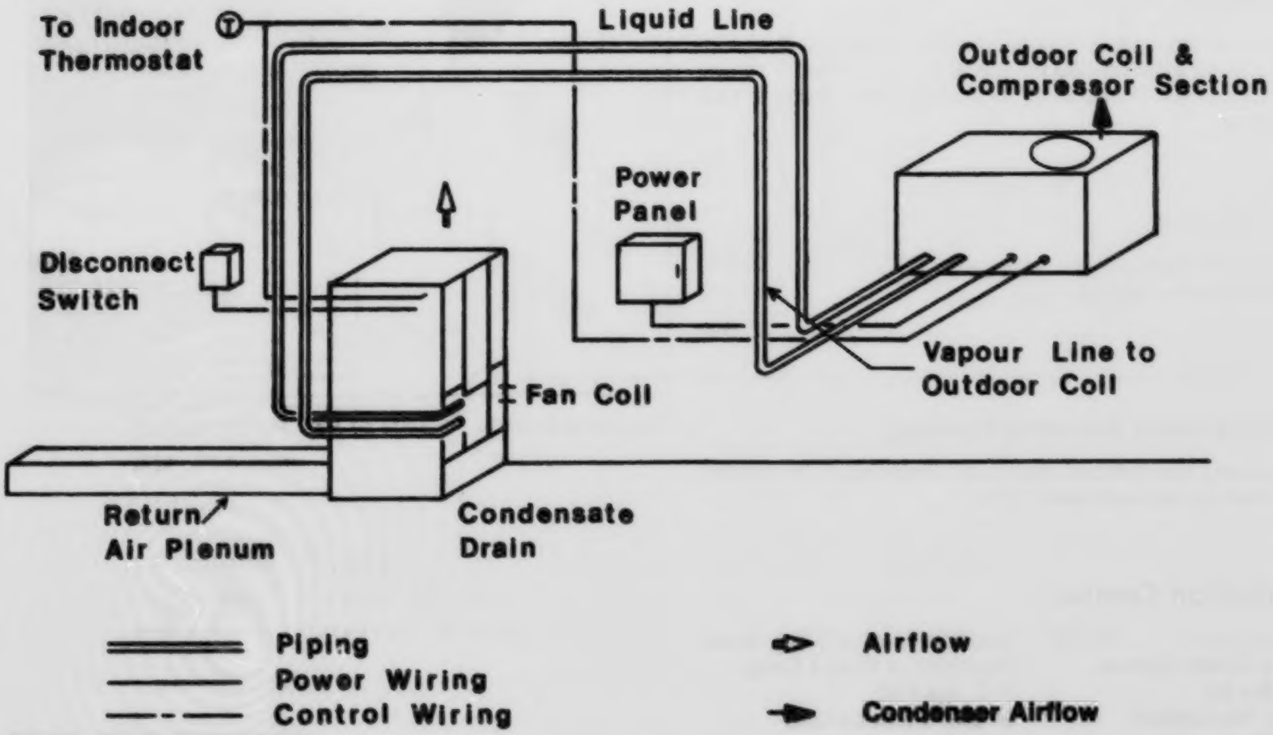
Monitoring Evaluation:

The proponent has installed an indoor/outdoor thermometer and a running hour meter to log operating temperatures and ON time of the heat pump for the first year of use.

Technical Details/Specifications:

The York split system heat pump installed in Mr. Winters' home has a heating capacity of 10.7 kW and a C.O.P. of 3.1 at 8.3 °C. This unit is complete with electric duct heaters, night setback thermostats, and a blower with ductwork. The York heat pump is in two units; (1) A condenser and (2) An outdoor coil and compressor section.

Schematic Diagram of Air-to-air Heat Pump System.


To Indoor Thermostat
T
Liquid Line
Outdoor Coil & Compressor Section
Power Panel
Disconnect Switch
Fan Coil
Vapour Line to Outdoor Coil
Return Air Plenum
Condensate Drain
Piping
Power Wiring
Control Wiring
Airflow
Condenser Airflow

Water-to-air Heat Pump
William Newton

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Pine Line, Torbay

Project Manager:
William Newton

Date:
March, 1985

Project Number:
03:04:22:07

Status:
Complete

Technology:
Heat Pump

Sector:
Residential

Province:
Newfoundland & Labrador

Purpose:

To demonstrate heat pump technology as a practical alternative to conventional home heating systems, particularly in rural areas of Newfoundland where water wells are common and water disposal does not create a problem.

Description:

The owner installed a water-to-air heat pump in his 232 m^2 (2500 ft^2) home with a well as the heat source. His existing electric heating system serves as a back-up.

Contributors:

William Newton	$2,200
Canada/Newfoundland	$2,320
Total	$4,520

Demonstrated Benefits/Savings:

Actual 21% reduction in conventional energy consumption, resulting in an annual cost saving of $189 and energy savings of 4200 kWh (15.21 GJ) annually.

Water-to-air heat pump installed.

Information Contact:

William Newton
P. O. Box 8272, Stn. 'A'
St. John's, Newfoundland
A1B 3N4
(709) 437-6232

or

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

WATER-TO-AIR HEAT PUMP

Economic Analysis:

Project Costs

Capital Cost	$3,550
Installation Cost	$ 870
Total Installed Cost	$4,420
Monitoring & Technology Transfer	$ 100
Total Demonstration Cost	$4,520

Operating Costs

Pre-demonstration	$ 900
Actual post-demonstration	$ 711
Net annual fuel savings	$ 189
Simple Payback Period: 23.3 years	23.3 years

Monitoring Evaluation:

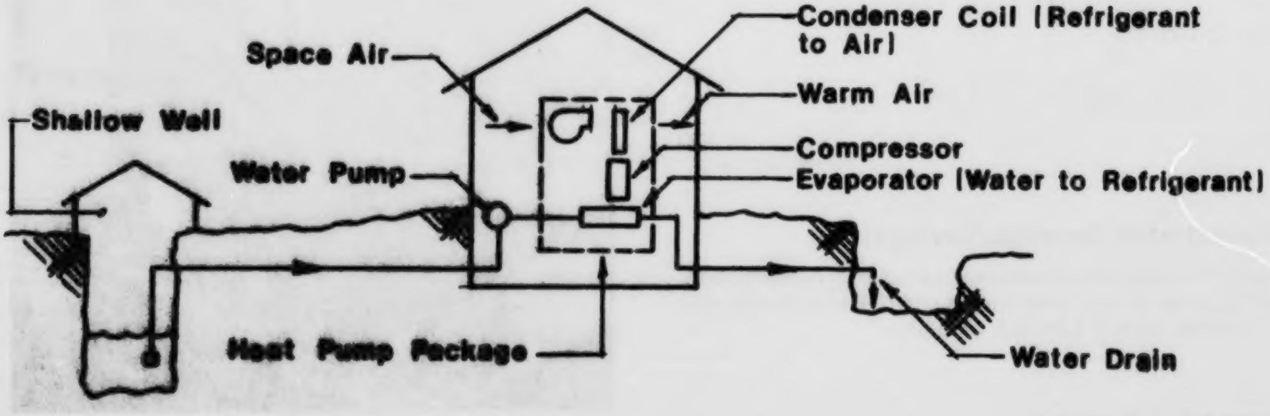
The energy consumption of the heat pump and the backup were monitored monthly. Water temperatures and flow rates were also recorded.

Problems encountered: The unit may not have been properly matched to the ground water temperature, flow rate and the house heating requirements. This led to actual savings of 21% as opposed to the expected savings of 50%. Low well capacity has not allowed the owner to take full advantage of this system, since the well is also the domestic water source.

Technical Details/Specifications:

The heat pump extracts heat from water in a well which has a flow rate of 45 L per minute at a temperature of 12°C. The water for the system is pumped at 22 L per minute to generate a heat source of about 2.5 kW for every one kW consumed. The used water is drained into a storm sewer and the extracted heat is transferred to the air and directed through the house.

Schematic Diagram of Installed Water-to-air Heat Pump


Condenser Coil [Refrigerant to Air]
Space Air
Warm Air
Shallow Well
Compressor
Water Pump
Evaporator [Water to Refrigerant]
Heat Pump Package
Water Drain

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Newfoundland
& Labrador

Water-to-air Heat Pump

Robin Shaw

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Mount Pearl

Project Manager:
Robin Shaw

Date:
March, 1985

Project Number:
03:04:22:08

Status:
Complete

Technology:
Heat Pump

Sector:
Residential/Commercial

Province:
Newfoundland & Labrador

Purpose:

To demonstrate energy conservation by using a water-to-air heat pump in a residence/office installation.

Description:

A unitary water-to-air heat pump is used to provide space heating. The heat source is a shallow ground water well, from which water was pumped through the evaporator and then drained to a ditch. The heat sink is the indoor condenser which distributes the heat through the residence by warm air ducts.

Contributors:

Robin Shaw	$2,600
Canada/Newfoundland	$2,500
Total	$5,100

Demonstrated Benefits/Savings:

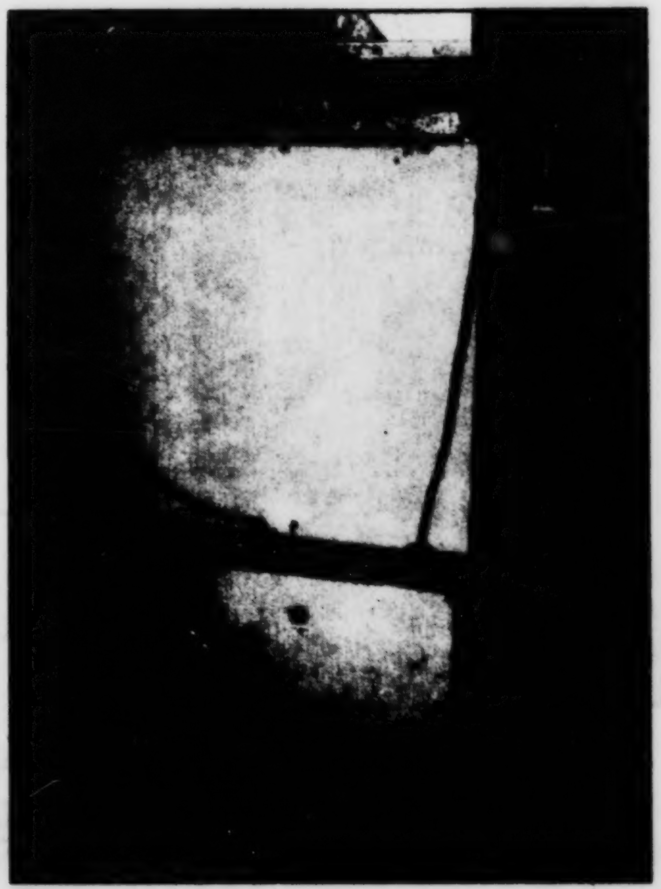
A 52% reduction in energy costs was achieved in the first year of operation. The dollar value associated with this saving was $1,100.

Information Contact:

Robin Shaw
69 Park Avenue
Mount Pearl, Newfoundland
A1N 2C2
(709) 368-7565

or

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland A1C 5T7
(709) 576-2411



The heat pump installed.

SMALL SCALE PROJECT

WATER-TO-AIR HEAT PUMP

Economic Analysis:

Project Costs

Materials	$ 3,400
Installation	$ 1,400
Total Installed Cost	$ 4,800
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$ 5,100

Operating Costs

Pre Demonstration Annual Energy Cost	$ 2,100
Post Demonstration Annual Energy Cost	$ 1,000
Net Annual Energy Savings	$ 1,100
Simple Payback Period:	4.4 yrs.

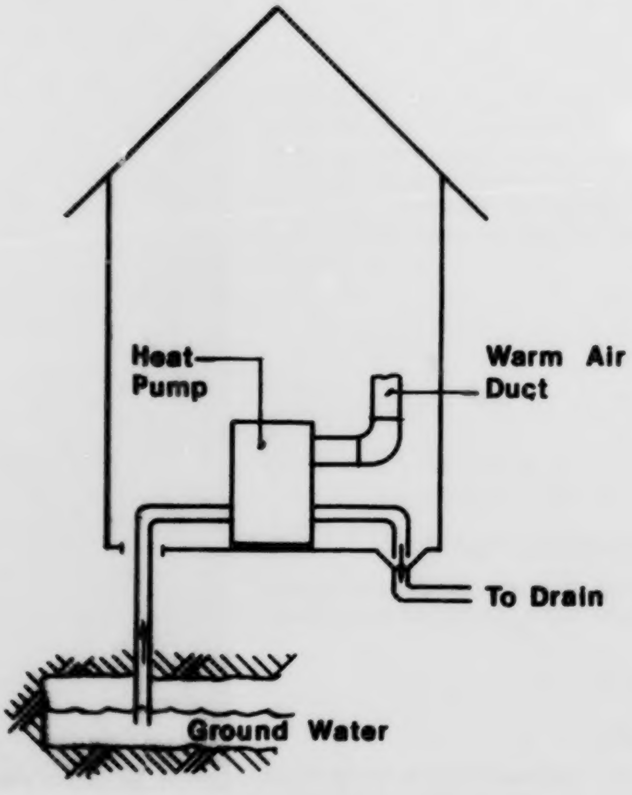
Monitoring Evaluation:

Fuel and electricity bills were collected for a full year after installation. Mr. Shaw found the heat pump to be noisy, therefore such systems should be placed in appropriate locations to minimize the problem.

Technical Details/Specifications:

This Aqua-matic water-to-air heat pump has a nominal output of 14 kW and a C.O.P. of 3.2. Ground water is pumped into the heat pump where the heat from the water is transferred to the air. The warm air is distributed throughout the house via ductwork, and the cooled ground water is dumped to a drain.

Schematic Diagram of Installed Water-to-air Heat Pump



Air-to-water Heat Pump
D. Thompson

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
St. John's

Project Manager:
D. Thompson

Date:
August, 1985

Project Number:
Not Applicable

Status:
Complete

Technology:
Conservation
(Heat Pumps)

Sector:
Residential

Province:
Newfoundland

Purpose:

To reduce oil consumption in an existing 185m^2 dwelling by using an air-to-water heat pump to supplement the oil heating system.

Description:

An air to water heat pump and a heat exchanger are being used to heat the water in a hot water radiation heating system.

Contributors:

D. Thompson...$5,200
(this project was not funded by CREDA)

Demonstrated Benefits/Savings:

This system has reduced heating costs by $1,344 per year. This represents a reduction in energy consumption of 50%.

The outdoor coil and compressor unit.

Information Contact:

D. Thompson
Heating Products Ltd.
St. John's, Nfld.
A1C 5L4
Phone: (709) 753-7344

or

Information Section
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

AIR-TO-WATER HEAT PUMP

Economic Analysis:

Project Costs	
Capital	$3,900
Installation	$1,300
Total Installed Cost	$5,200
Monitoring & Technology Transfer	$ 500
Total Demonstration Cost	$ 500 (information transfer only)
Operating Costs	
Pre-Installation	$2,695
Post-Installation	$1,344
Net Savings	$1,351
Simple Payback Period	3.9 years

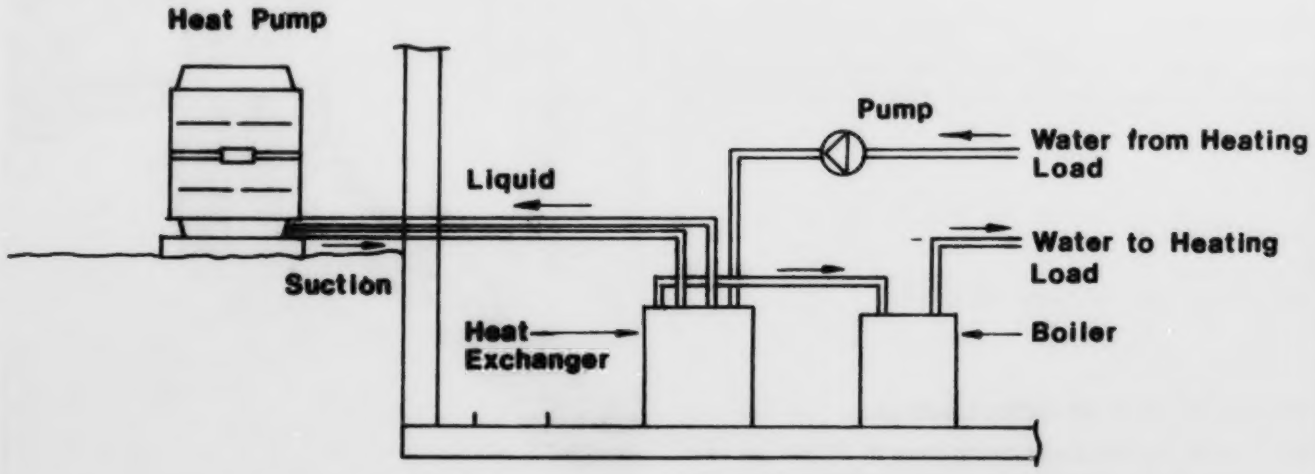
Monitoring Evaluation:

Mr. Thompson has kept a record of fuel and electricity consumption before and after the installation of the heat pump. A record of a year's operation before and after the installation is available.

Technical Details/Specifications:

A Carrier III air-to-water heat pump extracts heat from the air and transfer it to a liquid medium (glycol antifreeze). The heated liquid flows in a loop through a heat exchanger, where heat is transfered to the water in the hot water radiation heating system of the house. The heat pump has an output of 17kW with a C.O.P. of 2.9 at 8.3°C.

Schematic Diagram of Air to Water Heat Pump



4.1.3 Observations

Most of the heat pumps show a very reasonable payback period with the more successful projects averaging 7.1 years. The air-to-air heat pumps were generally the most successful however, the air-to-water heat pump owned by Mr. D. Thompson was the most successful project. Other heat pumps showed varying degrees of success with the payback period reaching a maximum of 23.2 years.

4.1.3.1 Air-to-Air Space Heat

By far the most popular type of heat pump was the air-to-air type. There were different brands of air-to-air heat pumps used and usually they showed a reasonable payback period of 6 to 9.9 years with the installed cost of these systems ranging from $3,400 to $6,400. A large part of the expense of installation of air-to-air or water-to-air heat pumps is the installation of the ductwork required to circulate the air. Ductwork will require careful design if the system is to operate properly and have an economical installation cost. While the supplier of the heat pump may be able to select the heat pump, he may not be able to design the ductwork system.

4.1.3.2 Air-to-Water Space Heat

The air-to-water heat pump installed by Mr. D. Thompson is very successful because it uses a heat source external to his house. His own careful engineering design and proper installation has insured a very good return for this investment.

4.1.3.3 Air-to-Water Domestic Hot Water

Mr. L. Cashin has installed an air-to-water heat pump to capture excess heat from his furnace room to preheat his domestic hot water. In the southern United States it is desirable to extract heat from the house air in an effort to provide air conditioning. The excess heat can easily be used to preheat domestic hot water especially where air conditioning is required for nearly 90% of the year. However, in Newfoundland, it is not feasible to preheat domestic hot water by chilling the house. Mr. Cashin's unit uses heat from the furnace room to preheat the domestic hot water. What was never fully considered was the fact that this heat normally found its way into the rest of the house. By using this heat as a source for the heat pump, more heat was required to heat his home and as a result his space heating costs increased.

However if this technology was properly applied by installing it in its own sunspace (a small lean-to on the south side) or in an existing sunspace, tests have shown that this can be effective way of capturing energy from the sun. Another possibility is to install the heat pump in the attic to capture the heat of the attic space. Of course, proper freeze protection would be required for the winter months.

4.1.3.4 Water-to-Air Space Heat

Mr. R. Shaw and Mr. W. Newton have each installed water-to-air heat pumps in their homes.

4.1.3.4 Water-to-Air Space Heat (Cont'd)

Mr. Shaw's heat pump was quite successful and has demonstrated it will pay for itself in 4.4 years. There was only one slight problem however, Mr. Shaw mentioned that his water-to-air heat pump was excessively noisy. It does not appear that there is anything wrong with this heat pump and it has been running efficiently for well over a year.

The other heat pump which does not demonstrate a good payback period is owned by Mr. W. Newton. This water-to-air heat pump uses ground water from a well as its heat source and then dumps the water into a down drain. Unfortunately, the well capacity is not great enough to supply a sufficient flow rate to the heat pump, and as a result the heat pump is not running efficiently. He has now decided to abandon the heat pump for the time being. This points out that an adequate water supply is essential for the success for the water-to-air heat pump.

4.1.4 Cost/Benefit Analysis

Most of the heat pump projects demonstrated a very reasonable return for the investment. The relatively high cost of these projects often makes them a big investment even for homeowners with above average incomes. However, when operating properly, the return on the investment can be quite substantial making them a most attractive investment.

4.1.5 Conclusions

All of the projects except for Mr. Cashin's and Mr. Newton's are operating successfully and are displacing a reasonable proportion of the original home heating costs. The monitoring results in every case show savings.

In the most cases, a reasonable payback period of 6 to 10 years was demonstrated. The capital cost of each project was relatively high, averaging $4,400. Since the paybacks are in excess of 5 years, heat pump installation should be considered only after the home has been made energy efficient. This is because it is usually cheaper and much more cost effective to implement improvements such as insulating and weatherstripping. Overall heat pumps can reduce the total heating bills by as much as 50% if they are sized and installed properly.

4.1.6 Recommendations

Heat pumps are not "off the shelf" packages that can be installed by the homeowner. The demonstrations showed that in order to ensure successful operation careful consideration must be given to the type of heat pump, the heat source used, its suitability to match the heating requirement, and the installation.

It is advisable for future government programs to continue to sponsor demonstrations in the air-to-water heat pump space heat systems for small commercial establishments. There are considerable opportunities to reduce the overall energy use in this sector.

4.1.6 Recommendations (Cont'd)

There is also is an opportunity to apply high temperature heat pumps in industrial (e.g. fish plant) sectors to reclaim the waste heat from refrigeration systems. This should be considered for supporting a demonstration project.

TABLE 1

HEAT PUMP PROJECTS

PROPONENT	TYPE	PROJECT COST	PAYBACK PERIOD	APPLICATION
C.J. O'Driscoll	Air to Air	$5,925	9.9 years	Space Heat
F.M. Stanley	Air to Air	$3,425	6 years	Space Heat
L. Cashin	Air to Water	$1,708	21.4 years	Domestic Hot Water
A. Bonia	Air to Air	$3,914	8.5 years	Space Heat
S. Winters	Air to Air	$6,391	6.6 years	Space Heat
W. Newton	Water to Air	$4,420	23.3 years	Space Heat
R. Shaw	Water to Air	$4,800	4.4 years	Space Heat
*D. Thompson	Air to Water	$5,200	3.9 years	Space Heat

*Not a funded project

4.2 Alternative Energy

4.2.1 Description

Alternative energy technologies make use of energy sources such as the sun, the wind, flowing water, wood and alternative petroleum by-products (propane) that have not been fully exploited in this province. The goal of these projects was to reduce the dependency of the proponent on conventional forms of energy such as gasoline, oil, and electricity and in some cases provide electricity to places not serviced by an electrical utility company.

There were six different alternative energy technologies with eight projects approved for funding under the Small Scale Energy Demonstration Program. These were:(1) Micro-Hydro,(2) Photovoltaics, (3) 2-Wind Energy Conversion System (W.E.C.S.), (4) 2-Solar Thermal Heating, (5) Alternative Wood Heating, and(6) Propane Powered Cars. Unfortunately there is very little information available on the micro-hydro project however, its theory of operation will be discussed.

4.2.2 Program Applications

Of the eight funded projects six of them are now complete. Table 2 (Page 21) shows lists of proponents, project costs, payback periods, and applications. These projects had payback periods ranging from 4 to 85 years. The capital costs ranged from $8,000 to $15,151.

4.2.3 Observation

Complete monitoring data based upon one year's operation after installation is unavailable for most of these projects and as a result payback periods are often based on estimates.

4.2.3.1 Wind Energy Conversion Systems (W.E.C.S.)

Two wind energy conversion systems projects were funded under the program: Mr. R. King in St. John's, and Mr. E. Duffy in Aguathuna.

R. King: St. John's

Mr. King's system is working properly and is providing the only source of electricity for his home, but its annual energy output is very low. The installation allows Mr. King to recharge his batteries at his house instead of at a service station which was his procedure before the WECS installation. This, however, cannot be classified as legitimate energy savings. He may save money but it is certainly not the usual practice for someone to spend a large amount of money to recharge batteries at a service station for everyday use.

E. Duffy: Aguathuna

Mr. E. Duffy's system is not operating properly and he is only obtaining a fraction of the theoretical output of his system. There are several possible explanations for this poor performance. These are: (1) Wind speed is too high much of the time and as a result the turbine cuts out on overspeed protection, (2) The swivel mount does not turn fast enough to catch the wind at an optimum

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Government of
Newfoundland
& Labrador

Wind Generated Electricity

Robert King

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

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Project Location:
St. John's

Project Manager:
Robert King
St. John's

Date:
March, 1985

Project Number:
571:06:03:04:22:(2):01

Status:
Complete

Technology:
Wind Generated Electricity

Sector:
Residential

Province:
Newfoundland & Labrador

Purpose:

To use a wind driven generator to charge a battery bank used as the sole source of electricity for a residence.

Description:

The horizontal axis wind turbine replaces the necessity for twice weekly charging a 12 V.d.c. battery bank. The nominal wind turbine generating capacity is 450 watts at 11.1 m/s (25 mph). The system also provides 110 V.a.c. through a rotary inverter for water pumping.

Contributors:

Robert King	$1,605
Canada/Newfoundland	$3,420
Total	$5,025

Demonstrated Benefits/Savings:

The total cost for the first year of connection to the power grid would be $7,000. This includes $6,500 for the pole line installation and $500 for the electricity used. The cost of installing the wind turbine is $4,800. In the first year the Owner saves $500 in battery recharging costs and avoids the added cost of the pole line installation.

Information Contact:

Robert King
P. O. Box 341
Mount Pearl, Newfoundland
A1N 2C3
(709) 776-9686

or

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-2411

The wind generator in position next to the house.

SMALL SCALE PROJECT

WIND GENERATED ELECTRICITY

Economic Analysis:

Project Costs

Capital	$3,322
Installation	$1,403
Total Installed Cost	$4,725
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$5,025

Operating Cost

Pre Demonstration	$ 500
Post Demonstration	$ nil
Net Savings	$ 500
Simple Payback Period:	9.5 years

Monitoring Evaluation:

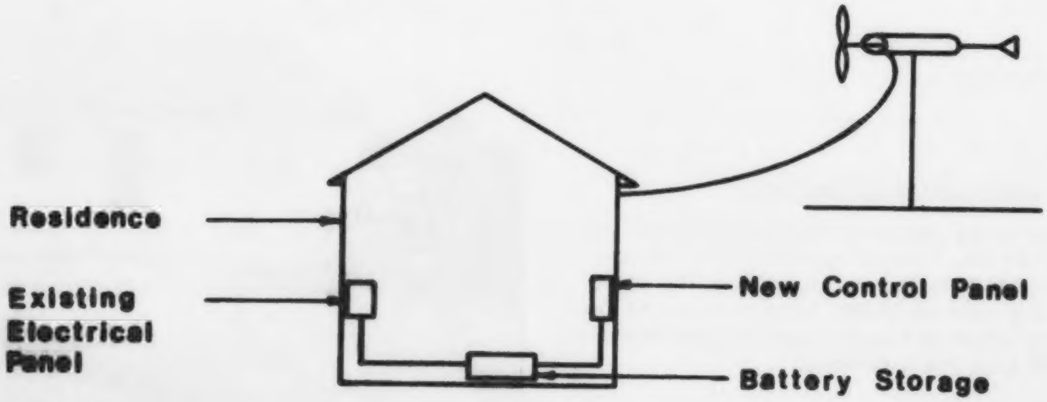
Mr. King has taken the following data measurements for the last year:

1) Wind speed measurements.
2) Daily power production by wind driven generator
3) Daily residential energy demand, and
4) Maintenance required by the system.

Technical Details/Specifications:

Mr. King has installed a Windcharger horizontal axis wind powered turbine on his property. The turbine charges a 550 ampere-hour bank of 12 V.d.c. industrial lift truck batteries which provides 10 days of energy storage. An electro-mechanical rotary inverter converts the 12 V.d.c. to 110 V.a.c for water pumping and kitchen appliances. The maximum output of the wind turbine is 450 watts at 11.1 m/s (25 mph). In St. John's with an average annual windspeed of 6.7 m/s. (15 mph) the annual output is 800 kWh. The owner avoids the necessity of twice weekly recharging of the battery bank which was done before installation of the wind turbine.

Schematic Diagram of the Installed 12V Wind Generator Set.



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Government of
Newfoundland
& Labrador

Wind Driven Generator

Edward Duffy

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Aguathuna

Project Manager:
Edward Duffy
Aguathuna

Date:
August 1985

Project Number:
03:04:22:07

Status:
Complete

Technology:
Renewable energy
(Alternate sources)

Sector:
Residential

Province:
Newfoundland

Purpose:

To demonstrate the use of a wind driven electricity generator to supply part of the electrical energy consumed in a residence.

Description:

The wind generator is connected in parallel with the normal electrical service. Use of the power generated is immediate; no provision for storing excess energy was made, and an over-demand is met from the utility supply. The nominal generator capacity is 1800 Watts @ 10.7m/s (24mph.).

Contributors:

E. Duffy	$4,253
Canada/Newfoundland	$4,553
Total	$8,806

Demonstrated Benefits/Savings:

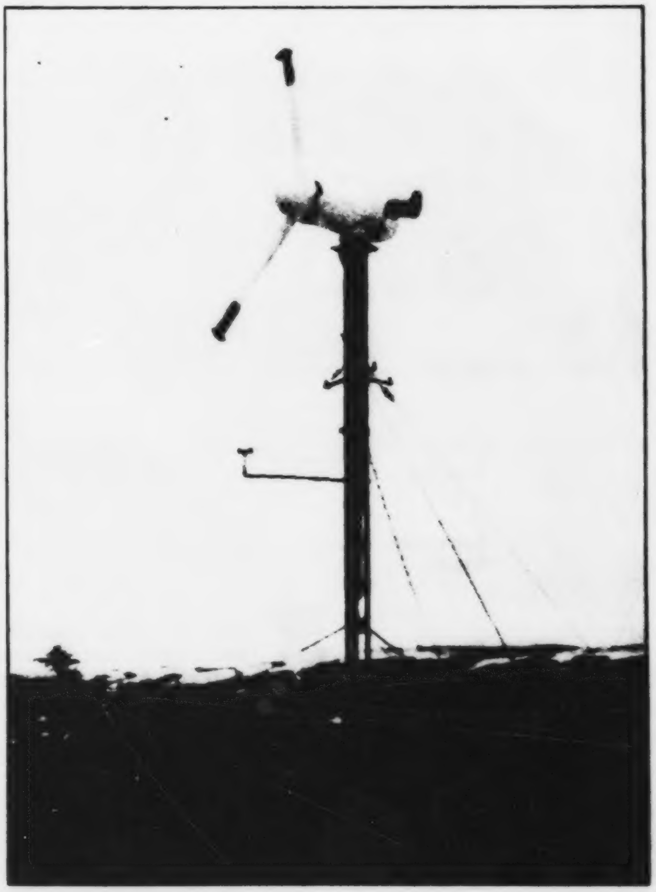
The residence consumes approximately 25,000 kWh annually at a cost of $1,000 (1982 rates). The estimated annual wind generator energy output was 6,000 kWh, however the actual power production is 25% of the quoted values. The resulting saving is approximately $100 per year.

Information Contact:

Edward Duffy
P. O. Box 10
Aguathuna, Nfld.
A0N 1A0
Phone: (709) 648-9480

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone (709) 576-2411



Enertech 1800 wind generator.

SMALL SCALE PROJECT

WIND DRIVEN GENERATOR

Economic Analysis:

Project Costs	
Capital	$6,465
Installation	$2,041
Total Installed Cost	$8,506
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$8,806
Operating Costs	
Pre-Installation	$1,510
Post-Installation	$1,410
Net Saving	$ 100
Simple Payback Period	85 years

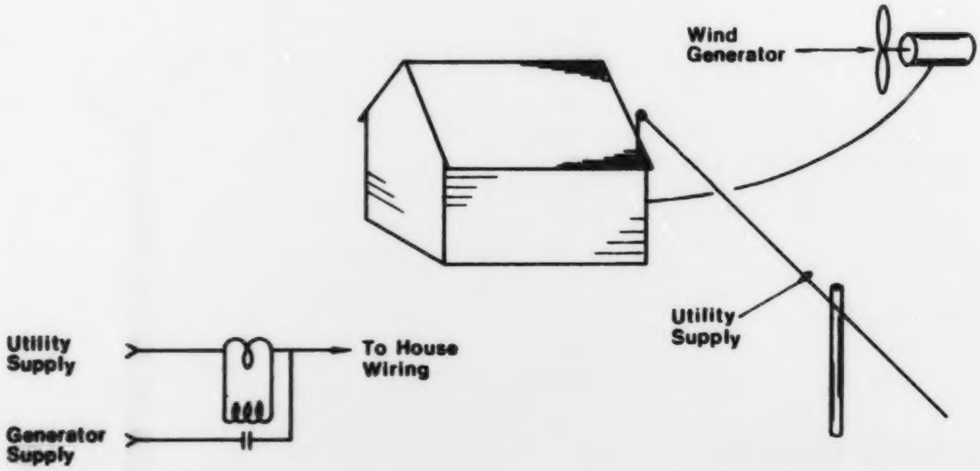
Monitoring/Evaluation:

Wind speed and electrical power measurements, and utility bills have been collected for the last year and a half. The exact cause of the poor performance is unknown.

Technical Details/Specifications:

The unit installed is an Enertech 1800 horizontal axis wind powered generator. It is capable of an output of 1800 Watts at a wind speed of 10.7 m/s. It has a cut-in wind speed of 3.1 m/s, a cut out wind speed of 17.9 m/s and a survival wind-speed of 54 m/s. The wind generator produces 110 volts ac which is distributed by the house electrical service panel.

Schematic Diagram of Wind Driven Generator



Note:
Upon Loss of Utility Supply, the generator is isolated from the house wiring, preventing re-energizing of of electrically dead utility lines.

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Solar Heating of Club Swimming Pool
Royal Newfoundland Yacht Club

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Long Pond
Conception Bay South

Project Manager:
A. Burgess
Royal Newfoundland
Yacht Club

Date:
August, 1985

Project Number:
03:04:22(2):44
Status:
Completed

Technology:
Solar Water Heating

Sector:
Recreational (Pools)
Province:
Newfoundland

Purpose:

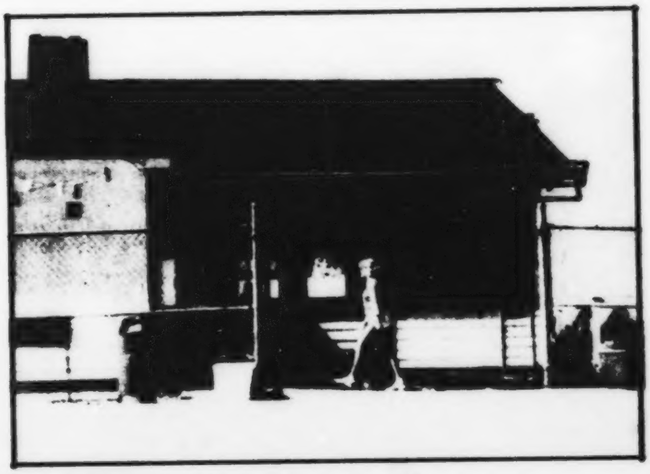
To demonstrate the use of an array of solar collectors to reduce fuel requirements for heating at a private club swimming pool.

Description:

Twenty-nine square meters of roof mounted thermal solar collectors were installed to heat a 32.5 square metre swimming pool.

Contributors:

RNYC	$1,818
Canada/Newfoundland	$3,627
Total	$5,445



The Collector panel mounted on the roof.

Demonstrated Benefits/Savings:

The solar heating system will provide energy savings of 66 per cent, or $1,330 over the average swimming season.

Further Information:

A booklet on solar energy in Newfoundland is available from Mines and Energy.

Information Contact:

A Burgess
Royal Nfld. Yacht Club
Long Pond
Conception Bay
Newfoundland
A0A 3Y0
Phone: (709) 834-5151

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

SOLAR WATER HEATING

Economic Analysis

Project Costs

Materials	$4,595
Installation	$ 750
Total Installed Cost	$5,345
Monitoring & Technology Transfer	$ 100
Total Demonstration Cost	$5,445

Operating Costs (Pool Heating)

Pre-Installation	$2,000
Post-Installation	$ 670
Net Savings	$1,330
Simply Payback Period	4 years

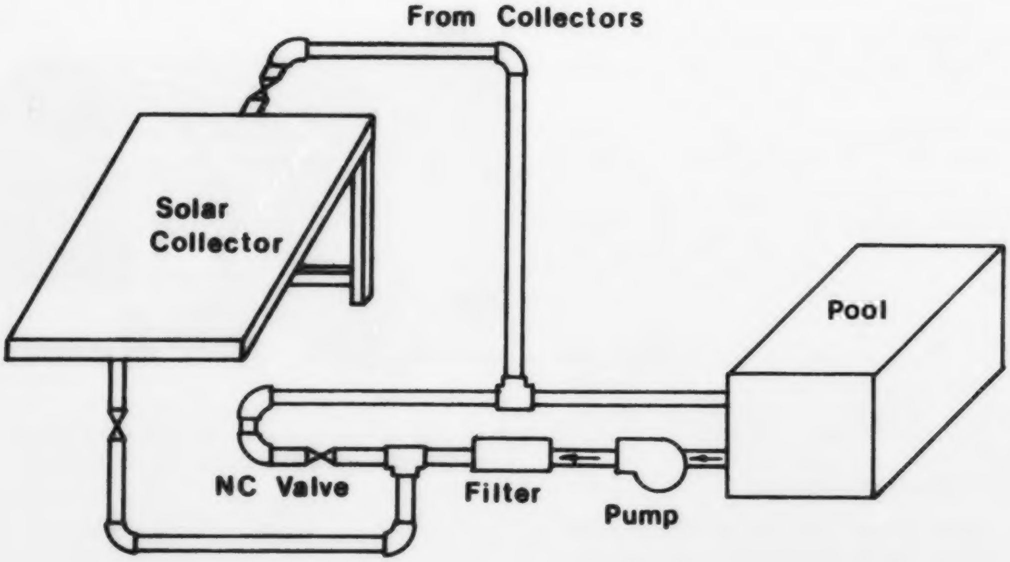
Monitoring/Evaluation:

System performance was measured with max/min thermometers for daily outside air and thermometers on poolwater temperature before and after collectors. Flow rates were checked periodically. Records were kept of sunshine hours and fuel bills.

Technical Details/Specifications:

The 32.5 square meter pool is being heated by 40 Solartronics solar heaters. The maximum total output of the solar collectors is 16.52kW at a flow rate of 0.13L/seconds. Any additional heat required is supplied by a backup pool heater.

Initial test runs indicated that the system worked, and data for projecting savings were collected. However, an undersized circulation pump resulted in very low flow rates and filtration problems. A higher capacity pump is being installed.



SOLAR HEATED POOL SYSTEM

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Solar Heating for Residential Swimming Pool
Neville Kean

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Deer Lake

Project Manager:
Neville Kean

Date:
August, 1985

Project Number:
03:04:22(2):20

Status:
Complete

Technology:
Renewable Energy (Solar)

Sector
Recreational (Pools)

Province:
Newfoundland

Purpose:

To demonstrate the use of an array of solar collectors to heat a residential, outdoor swimming pool.

Description:

Eight solar collectors were mounted on a separate, south facing frame beside the pool. The sun heats the pool water which is circulated through the solar collectors. The pool is approximately 6 m x 12 m, and holds 136,000 L of water.

Contributors:

N. Kean	$2,572
Canada/Newfoundland	$3,169
Total	$5,741

Demonstrated Benefits/Savings:

Solar heating is the only system installed in the pool and increases the length of the swimming season. Savings over other systems were calculated to be $800 per year for equivalent heating.

Further Information:

A booklet on solar heating in Newfoundland is available from Mines and Energy.

Information Contact:

Neville Kean
158 East Valley Road
Corner Brook, Nfld.
A2H 6C7
Phone: (709) 639-9739

or

Information Service
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

The collector panel and the pool.

SMALL SCALE PROJECT

SOLAR HEATING FOR RESIDENTIAL SWIMMING POOL

Economic Analysis:

Project Costs

Capital	$4,841
Installation	$ 700
Total Installed	$5,541
Monitoring & Technology Transfer	$ 200
Total Demonstration Cost	$5,741

Operating Costs

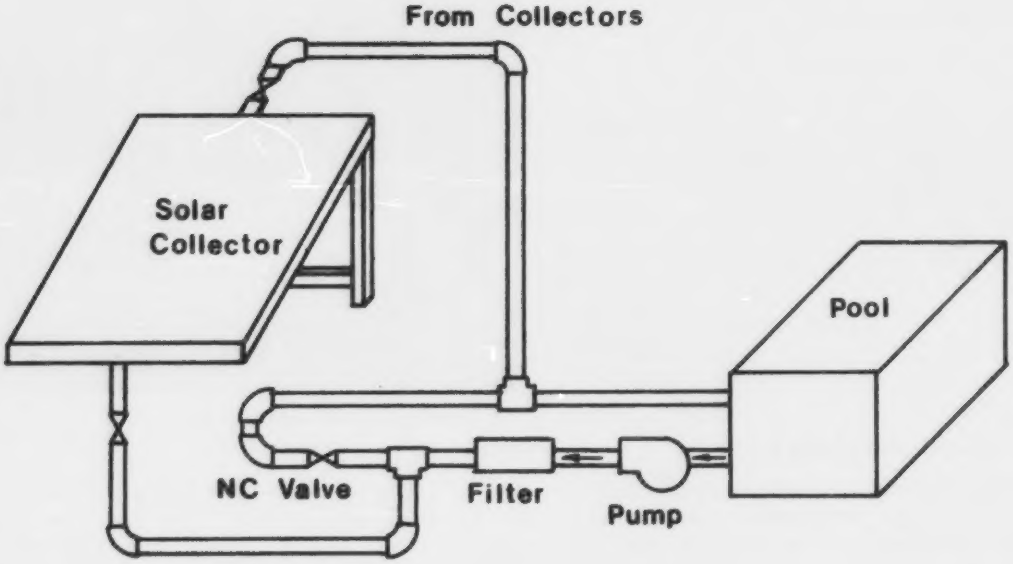
Propane System (fuel only)	$ 800
Solar System	0
Net Savings	$ 800
Simple Payback Period	7.1 years

Monitoring/Evaluation:

The items monitored included: max/min temperatures for daily outside air; temperature of the pool water before and after collectors; and flow rates. The system was not in full operation for the first summer, due to non-arrival of an automatic valve. When operated manually, the solar system easily kept the pool water heated.

Technical Details/Specification:

The owner's system consists of eight 1.22m x 3.05m Facco solar collector panels mounted on an "A" frame structure. This system provides the only source of heat to the pool which was previously unheated. Water is pumped from the pool at a rate of 15L/min. through the filter and into the solar collectors. When sufficiently warmed, automatic valves allow the water to flow back into the pool. This system is capable of raising the water temperature by 1°C to 3.5°C each day, depending on weather conditions.



SOLAR HEATED POOL SYSTEM

Propane Powered Car

Department of Transportation

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
St. John's

Project Manager:
Government of Newfoundland
and Labrador
Dept. of Transportation

Date:
August, 1985

Project Number:
03:04:22(2):06

Status:
Complete

Technology:
Renewable energy
(alternate sources)

Sector:
Government

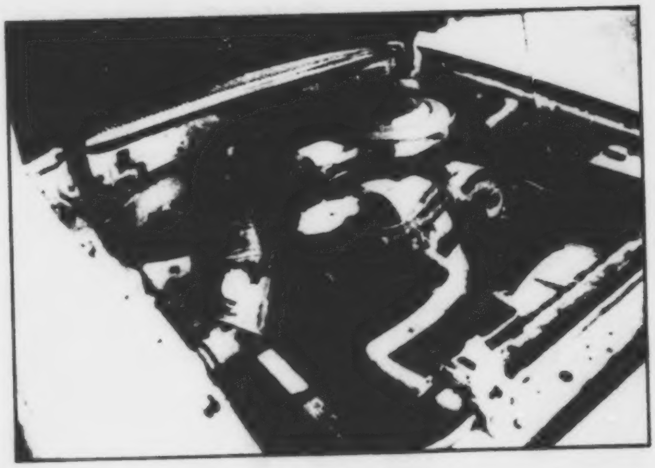
Province:
Newfoundland

Purpose:

To demonstrate the technical feasibility of propane as an alternative automobile fuel.

Description:

The Department of Transportation purchased an automobile with a factory installed propane-powered engine, rather than with a gasoline-powered engine.



The propane-powered 1982 Ford Granada.

Contributors:

Department of Transportation	$ 100.00
Canada/Newfoundland	$1,000.00
	$1,000.00

Demonstrated Benefits/Savings:

Because of the high cost of propane and scarcity of propane service stations (in this province) this fuel does not provide a practical alternative to gasoline.

Information Contact:

C. Warford or
Department of Transportation
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-3278

Information Section
Department of Mines & Energy
Energy Branch
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

PROPANE POWERED CAR

Economic Analysis:

Capital	$ 800
Installation (included)	$ 0
Total Installed Cost	$ 800
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$1,100

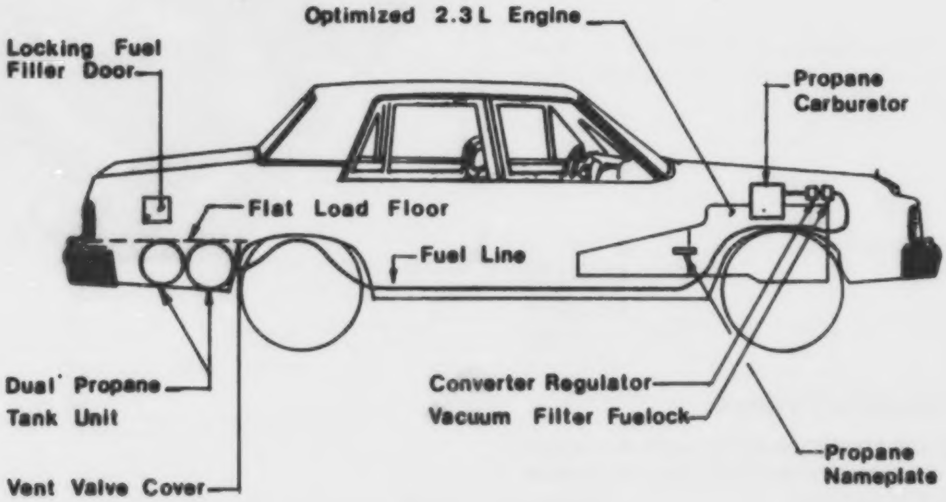
Monitoring/Evaluation:

The Department record shows that the car has a fuel consumption of 13.9 L/100 km. This compares with a similar car with a gasoline engine which consumes 8.7 L/100 km. Although the government price per litre of propane is lower than gasoline, the increased fuel consumption offsets this benefit for the Department. The actual cost of propane for the average Newfoundland consumer is higher than the cost of gasoline.

Technical Details:

A Ford Granada 4-door sedan with a factory installed 4 cylinder 2.3 litre propane engine, is being used by the Department of Transportation as their test vehicle. It has two fuel storage tanks with an overpressure relief valve, a vacuum filter fuelock, a converter-regulator, and a propane carburetor.

Schematic Diagram of Propane Powered Car


Optimized 2.3 L Engine
Locking Fuel Filler Door
Propane Carburetor
Flat Load Floor
Fuel Line
Dual Propane Tank Unit
Converter Regulator
Vacuum Filter Fuelock
Propane Nameplate
Vent Valve Cover

Energy, Mines and Resources Canada

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Mines & Energy
Government of
Newfoundland
& Labrador

Photovoltaic Generation

Bart Higgins

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Paradise River
Labrador

Project Manager:
Mr. Bart Higgins
Paradise River

Date:
August, 1985

Project Number:
03:04:22(2):16

Status:
Completed

Technology:
Renewable energy
(Alternate Sources)

Sector:
Residential

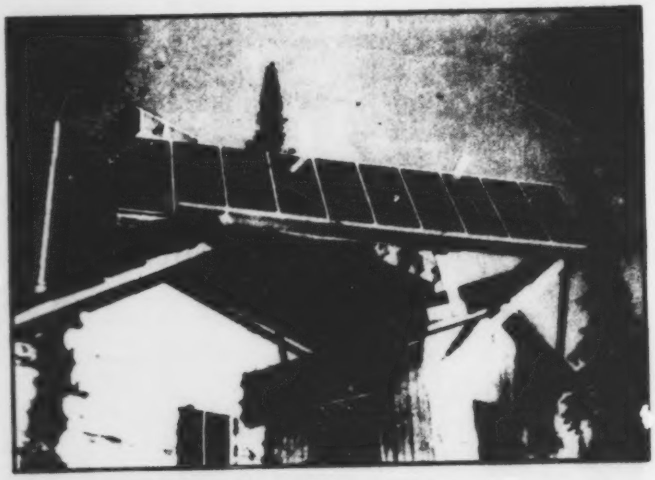
Province:
Newfoundland

Purpose:

To demonstrate the use of photovoltaic array in conjunction with a gasoline generator set and deep cycle batteries to offset energy costs at a private residence. The energy system is a remote power system with no interconnection to any utility.

Description:

The photovoltaic (PV) array is used to charge a 12 volt battery set during daylight hours. The gasoline generator is used intermittently to maintain the overall charge of the battery bank. The nominal PV array capacity is 350 Watts. The battery set stores energy sufficient for 5 days without supplemental power.



The array of photovoltaic panels.

Contributors:

B. Higgins	$ 5,150
Canada/Newfoundland	$11,300
Total	$16,450

Demonstrated Benefits/Savings:

Before the PV system installation, the total cost of energy in fossil fuels was $2,255 per year. The energy consumption is now projected to be $300 per year for a saving of 86.7%.

Information Contact:

B. Higgins/C. Liska
Paradise River
Labrador
A0K 3Y0
Phone: (709) 845-5239

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

PHOTOVOLTAIC GENERATION

Economic Analysis:

Project Costs	
Capital	$8,900
Installation	$ 6,250
Total Installation Cost	$15,150
Monitoring & Technology Transfer	$ 1,300
Total Demonstration Cost	$16,450
Operating Costs	
Pre-Installation (Gasoline & Kerosene)	$ 2,255
Post-Installation (Gasoline)	$ 300
Net Savings	$ 1,955
Simple Payback Period	7.7 years

Monitoring/Evaluation:

Two running hour meters (AC and DC) were installed to record system usage.

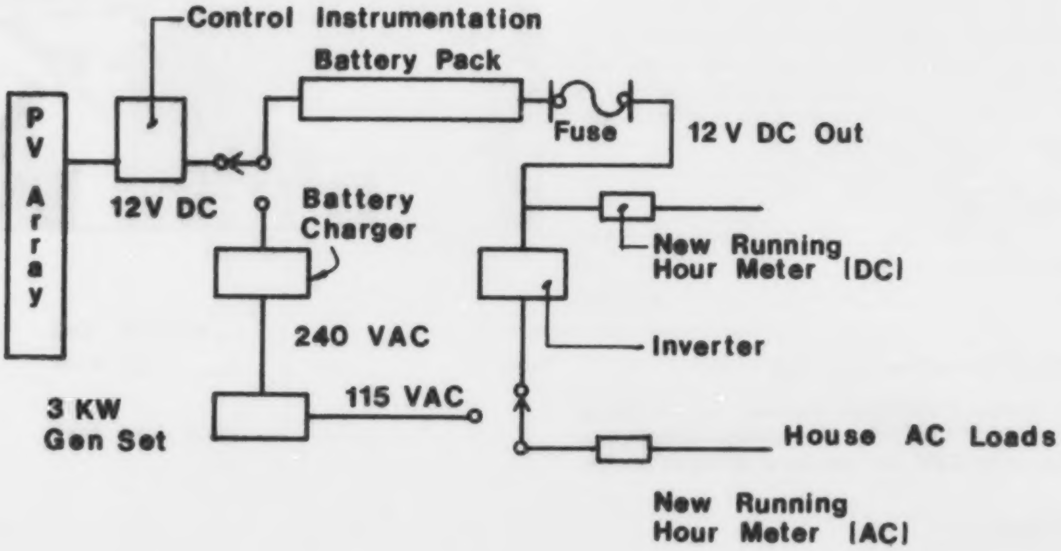
The proponents are taking daily logs of:

current & voltage from PV array
current & voltage from generator
AC and DC loads to house
hours of sunshine
hours of generator use
hours of kerosene lamps use

Technical Details/Specifications:

The PV system consists of 3 major subsystems. The first is the solar cell array, which consists of ten 35 watt Mobil solar cells, roof mounted at the optimum angle for collecting energy during the winter months. The second subsystem is the battery set which consists of a Gould Industrial truck battery rated at 12 volts dc and 1120 ampere-hours, and two 12 volt automotive batteries. The third subsection is the control panel which consists of power conditioning for the PV array and the gasoline generator, a 12 volts dc to 110 volts ac static inverter, a 12 volts dc distribution panel, and a 110 volts ac distribution panel.

Schematic Diagram of Photovoltaic Generation


Control Instrumentation
Battery Pack
Fuse
12 V DC Out
PV Array
12V DC
Battery Charger
New Running Hour Meter (DC)
240 VAC
Inverter
3 KW Gen Set
115 VAC
House AC Loads
New Running Hour Meter (AC)

Energy, Mines and
Resources Canada

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Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Finnish Fireplace

Michael Mason

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Paradise

Project Manager:
Michael Mason
28 Donna Road

Date:
August, 1985

Project Number:

Status:
Complete

Technology:
Renewable energy
(Wood heating)

Sector:
Residential

Province:
Newfoundland

Purpose:

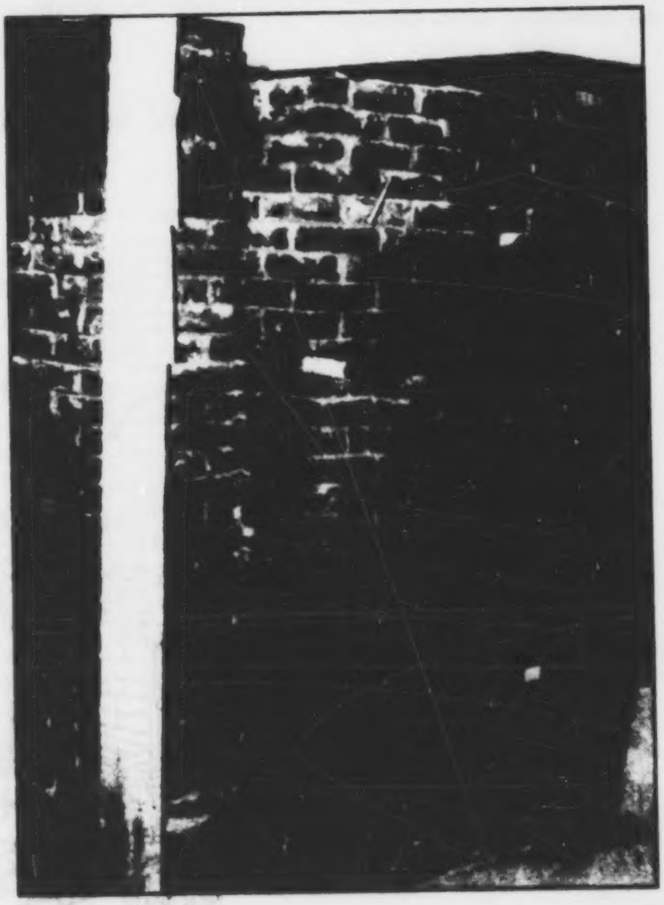
To demonstrate an extremely efficient and safe method of heating a home with wood.

Description:

The applicant has constructed a Finnish fireplace in his home. The fireplace incorporates a downdraft contraflow concept in which super-heated gas moves up a central fire tube, and then down both sides of the firebox through heat exchange channels at the sides and bottom of the heater.

Demonstrated Benefits/Savings

Based on three months data, savings are $550. This is down considerably from predictions, due to the fireplace not being used all the time, and the fact the wet wood is being burnt. Large improvements should be possible.



The Finnish fireplace.

Information Contact:

Michael Mason
28 Donna Road
P. O. Box 441
Paradise, Nfld.
A0E 2E0
Phone (709) 782-3163

or

Information Section
Energy Branch
Dept. of Mines & Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

FINNISH FIREPLACE

Economic Analysis:

Project Costs	
Capital	$3,890
Installation	$3,500
Total Installed Cost	$7,390
Monitoring Technology Transfer	$ 450
Total Demonstration Cost	$7,840
Operating Costs	
Pre-Installation Annual Energy Cost	$1,400
Post-Installation Annual Energy Cost	$ 850
Net Energy Savings	$ 550
Simple Payback Period	13.4 years

Monitoring/Evaluation:

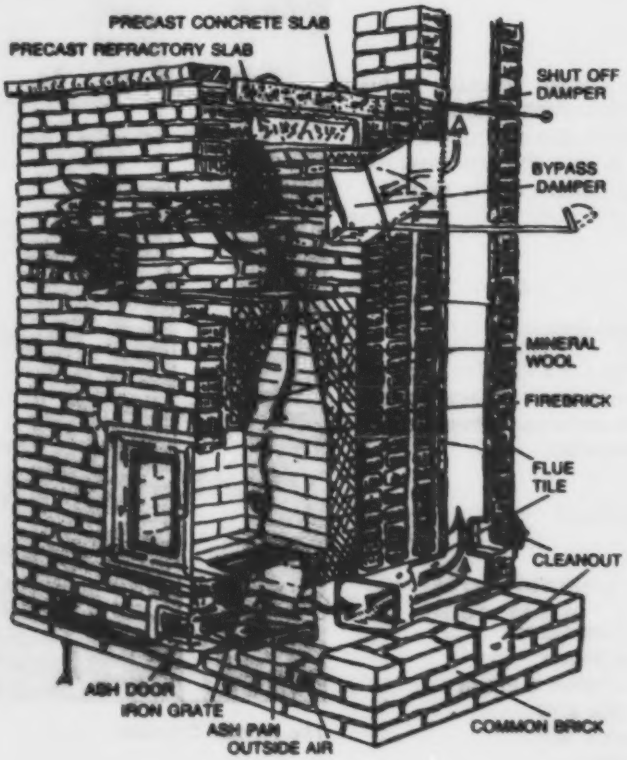
The proponent has compared heating bills before and after the installation of the fireplace.

Technical Details/Specifications:

From the combustion chamber, hot gasses rise into the upper chamber, then down outside the side walls of the combustion chamber and finally through a base flue into the chimney. Thus the whole masonry structure is heated. A damper-equipped by-pass vent is provided from the upper chamber directly into the chimney. The contraflow description is derived from the downward flow of these hot gasses and the upward flow of air outside the fireplace (due to convection).

The Finnish fireplace is operated with a very hot, quick fire, which thoroughly warms the massive structure. When combustion is finished, the chimney damper is closed. Sufficient heat should be stored for 12-24 hours. There are detail variations of the basic design. The fireplace built for the demonstration is rated at 11.7 - 17.6 kW (40,000 - 60,000 Btu/hr). A major benefit over conventional wood stoves is the avoidance of slow-burning fires, which greatly increase the creosote deposited in the chimney which forms a significant hazard.

Schematic Diagram of Finnish Fireplace


PRECAST CONCRETE SLAB
PRECAST REFRACTORY SLAB
SHUT OFF DAMPER
BYPASS DAMPER
MINERAL WOOL
FIREBRICK
FLUE TILE
CLEANOUT
COMMON BRICK
ASH DOOR
IRON GRATE
ASH PAN
OUTSIDE AIR

E. Duffy: Aguathuna (Cont'd)

orientation, (3) There is a technical malfunction with some part of the system, or (4) The turbine is undersized for its particular application.

One of these or perhaps a combination of these may be the reason for the poor performance of Mr. Duffy's wind energy conversion system.

These two projects clearly demonstrate the importance of careful project design. The potential to produce much more electrical energy exists in both cases. For a small increment in cost, both of these systems could yield a substantially greater output and a much better payback period.

4.2.3.2 Solar Thermal Heat

Unfortunately, neither of the solar thermal pool heating systems were fully operational in the first summer after the installation of the solar panels. An undersized circulator pump prevented The Royal Newfoundland Yacht Club from operating its solar panels and non-arrival of automatic control valves prevented Mr. N. Kean from operating his solar panels. When both pools were operated manually for a short period of time, increases in water temperatures were readily observed and therefore it has been demonstrated that both systems should work when their problems were rectified.

4.2.3.3 Propane Car

The propane powered car purchased by the Department of Transportation for an extra $800 is very similar to most other cars. A factory modification to the carburetor and fuel system and the substitution of propane fuel tanks for gasoline tanks allowed the car to operate on propane.

Although the car performed well from a mechanical point of view, it cost more to operate when using propane fuel than it would have if gasoline had been used. The car's fuel consumption was higher with propane than that of a similar car using gasoline, however, the higher price per litre of propane offset the fuel economy.

Unfortunately, even with the Department of Transportation not paying the road tax on propane, this car was not an economically feasible project. Individuals who purchase propane cars will find them even less feasible when they pay the road tax for the propane. In central Can- ada where propane is much cheaper, propane powered cars can be economically feasible alternatives to gasoline powered cars.

To determine the economic feasibility of using propane as a fuel it may not have been necessary to have purchased the car. Fuel consumption rates were available from the manufacturer and the Department of Transportation could have obtained the price per litre of propane and calculated the efficiency and operating cost compared to a gasoline or diesel model.

4.2.3.4 Photovoltaics

Mr. B. Higgins has the only photovoltaic system demonstrated. It is operating quite well saving him approximately $2,000 annually on fuel costs. He has used 10 Mobil solar cells mounted on his roof to charge a battery energy storage system. He has a 3 kW gasoline a.c. generator as backup. The distribution panel includes a 12 volt d.c. fuse panel, a d.c. to a.c. inverter, a 110 volt a.c. fuse panel and the control circuitry for charging the battery from the solar cells or the 3 kW gasoline generator.

This system demonstrates how a well designed system can provide a very favourable return on an investment. The success of this system can perhaps influence some other people to purchase their own photovoltaic systems in remote areas where gasoline generators are the only source of electricity.

4.2.3.5 Alternative Wood Heating

Mr. M. Mason has installed a Finnish Fireplace to help heat his home. This is a specially built fireplace which circulates hot gases around the sides of the fireplace. The heat is absorbed by the walls of the fireplace and released into the room. Its design is complex and its construction should be done by a master mason. While capable of a substantial output, it is not providing him with optimum performance. This is not the fault of the fireplace rather it is the fact that it is not being used all the time and that wet wood is sometimes being burned. If this fireplace were to be used properly, the payback period of 13.4 years based on 3 months of monitoring data could probably be reduced to 10 years or less.

4.2.3 6 Micro-hydro

Mr. H. Johnston proposed to construct a micro-hydro electric generating system. Unfortunately this project was halted during the initial part of construction. The cost of the project would probably have exceeded $20,000 but it could have supplied up to 5.8 kw of power for the domestic and commercial purposes of Mr. Johnson's farm. He had proposed a system with a diverted stream and a reservoir to power a specially designed generator. The total available head was 55 m. Because of personal circumstances the project was halted and its continuation is uncertain.

4.2.4 Cost/Benefit Analysis

In most cases the results of this part of the program were not as expected. Complete data is not available so accuracy in economic analysis is nearly impossible. Where these technologies were new to this province the wide range of success is not surprising. The ranking of the most attractive technologies are (1) solar heated pools, (2) the photovoltaic system and (3) the Finnish fireplace. Most surprisingly the wood projects were not as successful as originally anticipated.

4.2.5 Conclusions

Alternative energy technologies are a fairly recent development in Canada and are very new in Newfoundland. Many of the projects that were not successful may have succeeded if their suitability and application had been more carefully considered. Where new frontiers of engineering and science are involved, capital costs of projects will be fairly high due to the high costs of research and development. Capital costs have been declining while quality has been increasing in the solar thermal, and photovoltaic technologies. In other technologies, the costs have remained fairly constant as quality increases. Alternative energy systems can supply energy where none was previously available and can help reduce fuel costs in existing facilities.

4.2.6 Recommendations

All of the projects started could have shown a very favourable return on the investment. Overall, the basic ideas were sound but more attention should have been given to the system design. The following recommendations should be considered for future project funded by the government.

1) Proper engineering of the system is required especially for the wind energy conversion system. The W.E.C.S. could have been more successful had the design criteria been carefully considered and equipment properly selected.

4.2.6 Recommendations (Cont'd)

2) Careful research of expected benefits and savings is required. By obtaining laboratory tests standards, the Department of Transportation would have realized that the propane car was not at all economically viable here in Newfoundland. Also Mr. King might have realized that a 450 Watt wind energy conversion system, such as he has, would have not been worth his investment.

3) Systems should be properly operated. For example, the Finnish fireplace could provide much better results if it were operated properly.

4) Further demonstrations may be required in the photovoltaic and micro-hydro technologies in other geographic areas of the province for technology transfer purposes.

The relatively poor performance of some of these projects should not discourage people from using these technologies. The energy is there to use. It is only a matter effective system design.

TABLE 2

ALTERNATIVE ENERGY PROJECTS

PROPONENT	APPLICATION	PROJECT COST	PAYBACK
R. King	W.E.C.S.	$ 4,725	9.5
E. Duffy	W.E.C.S.	$ 8,506	85
RNYC	Solar Heated Pool	$ 5,345	4
N. Kean	Solar Heated Pool	$ 5,541	7.1
D.O.T.	Propane Car	$ 800	*
B. Higgins	Photovoltaic System	$15,150	7.7
M. Mason	Finnish Fireplace	$ 7,390	13.4
H. Johnson	Micro-Hydro	$ N/A	N/A

* Does not produce a payback period (no savings)

N/A Not Available

4.3 Waste Energy

4.3.1 Description

Waste fuel is a source of energy which to date has been greatly underutilized. Crankcase oil, lubricating oil, woodchips, wood slabs, even fish oil and farm biomass are but a few of the many sources of waste material capable of providing energy. By using special furnaces to burn these waste materials, energy costs can be reduced to a fraction of the original costs.

There were four types of waste fuels technologies with six projects funded under the Small Scale Energy Demonstration Project. These were: (1) 2 - Waste wood, (2) Fish Oil, (3) Waste Engine Oil, and (4) 2 - Chicken Litter waste.

Unfortunately there is no monitoring data available on the waste oil burner or on one of the chicken litter burners. The waste oil burner was not operational due to environmental problems while one of the chicken litter burners is not yet complete.

Energy, Mines and Resources Canada   Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Waste Fuel Burning Plant
George & Linda Van Koetsveld

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Coomb's Farm
Cormack, Nfld.

Project Manager:
George & Linda Van Koetsveld
Cormack

Date:
March, 1985

Project Number:
03:04:22:32

Status:
Complete

Technology:
Biomass Burning

Sector:
Agricultural

Province:
Newfoundland & Labrador

Purpose:

To demonstrate the practicality and economic viability of using a Hahsa heating plant for a commercial greenhouse.

Description:

The owner-built heating plant is designed to heat a residential or small commercial property. The unit burns a variety of fuels including wood, paper, woodchips or garbage. The owners are burning mostly wood slabs — a cheap and plentiful fuel in their area. The wood slabs are supplemented by locally cut hardwood.

Contributors:

Proponent	$3,462
Canada/Newfoundland	$3,763
Total	$7,225

Demonstrated Benefits/Savings:

Based on a comparable local operation the estimated annual heating cost is $3,375. The estimated cost of wood fuel supply slabs is $500 at $10 cord. An anticipated extra $500 per year pays for gasoline for a snowmobile, chainsaw repair and maintenance in the acquisition of hardwood. The total cost for acquiring fuel for the Hahsa is $1,000 with free labour by the owner.

The Van Koetsveld greenhouse attached to the house.

Information Contact:

George & Linda Van Koetsveld
Barony Produce
R.R. 2, Site 20, Box 1
Deer Lake, Newfoundland
A0K 2E0
(709) 635-3008

or

Information Section, Energy Branch
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

WASTE FUEL BURNING PLANT

Economic Analysis:

Project Costs

Capital	$6,125
Installation	$ 800
Total Installed Cost	$6,925
Monitoring and Technology Transfer	$ 300
Total Demonstration Cost	$7,225

Operating Costs

Pre demonstration	$3,735
Post-demonstration	$1,000
Net annual fuel savings	$2,735
Simple Payback period:	2.5 years

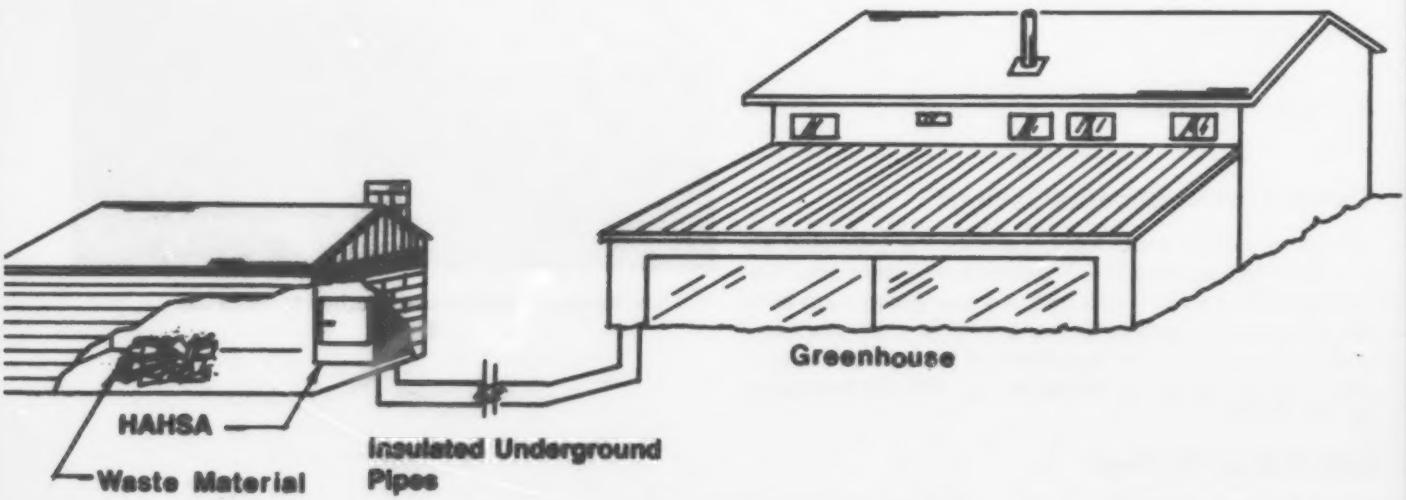
Monitoring Evaluation:

For two years, following project completion, the proponents monitored the waste burner's performance as follows: fuel used by type, the average length of burn for a loaded furnace, quantity of wood used, average greenhouse temperature produced, labour in hours per day to fuel burner, down times and problems.

Technical Details/Specifications:

The Heating and Heat Storage Apparatus (HAHSA) is a self contained heating system connected to the greenhouse by four insulated pipes. This system is basically a woodburner which is completely surrounded by more than 18 tonnes of sand. This mass of heat-storing sand is then surrounded by insulation and a weatherproof structure. In the sand and above the fire chamber are two heat exchangers. One heat exchanger is connected by 70 mm pipes to bring the return water, after it has heated the building, back to the heat exchanger to be reheated and later sent back to the building when the thermostat calls for heat. Two 12.5 mm pipes connect to the other heat exchanger; one brings cold water to the Hahsa and the other returns hot water to the greenhouse.

Schematic Diagram of Hahsa Heating System.



Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Mines & Energy
Newfoundland

Fuel Wood Distribution

Mr. Lorne Collins

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Hare Bay, Newfoundland

Project Manager:
Mr. Lorne Collins
Hare Bay
Bonavista North
Newfoundland

Date:
November, 1983

Project Number:
03:04:22:01

Status:
Completed

Technology:
Biomass,
Fuel Wood Distribution

Sector:
Residential/Commercial

Province:
Newfoundland

Purpose:

To demonstrate the commercial viability of vertically integrated domestic fuel wood distribution networks in Newfoundland.

Description:

The proponent harvested forest fire damaged hardwoods and softwoods for domestic consumption. This firewood was cut in 20 and 30 cm as well as 1.2 and 2.5 m units. The proponent made use of his general store in Hare Bay to arrange the sales which were later delivered to the residents. Fuel wood was also sold door to door and from the wood yard in Hare Bay.

Contributors:

Project Proponent	$ 7,076.69
Canada/Province	10,000.00
Total	$17,076.69

Expected Benefits/Savings:

Assuming 1812 m³ (500 cords) of fuel wood were to be cut and consumed, as estimated 160 m³ (1,000 barrels) of oil per year in the Bonavista North Region would be displaced. This would mean a $22,000 federal savings per year ($22 per .158 m³ subsidy).

Demonstrated Benefits/Savings:

761 m³ (210 cords) of wood were sold thus displacing 75 m³ (470 barrels) of oil. This translates to a saving for the federal government of $10,300.

Further Information:

Mr. Lorne Collins
Hare Bay, Bonavista Bay
Newfoundland
Phone: (709) 537-2069

or

Energy Branch
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 737-2411

Project Name:

Fuel Wood Distribution

Economic Analysis:

Project Costs:

Machinery and Operating		$ 3,979.70
Labour		13,097.00
	Total Project Cost	$17,076.70

Operating Cost to Homeowners:

Pre-demonstration (fuel cost assuming 35.4¢/L)	$27,000.00
Post-demonstration fuel cost for 761m^3 of wood	9,595.00
Fuel Savings	$17,405.00

Simple payback period: 8 months

Monitoring/Evaluation:

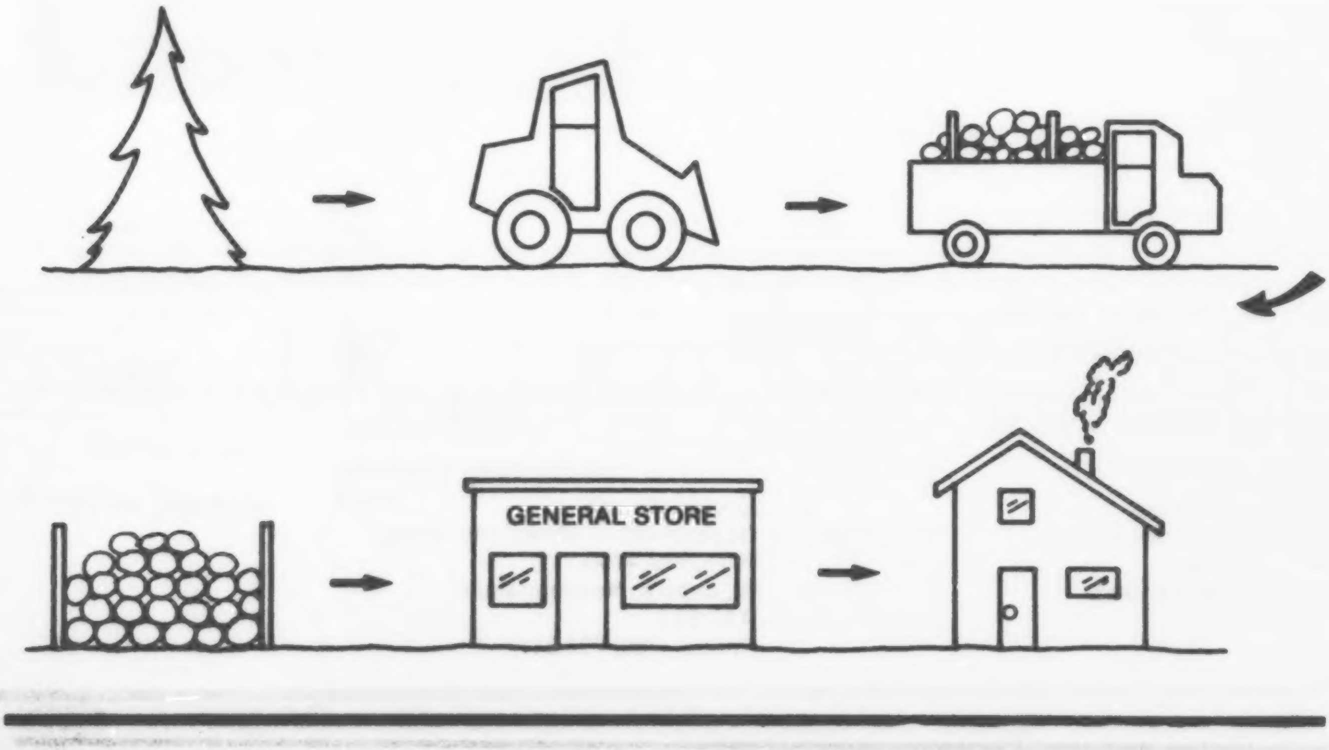
The project was monitored during the harvesting and selling period. People were pleased with the service, but because of the inclement weather, and difficulties with the machinery, the expected quota was not achieved.

Technical Details:

The equipment included 2-5 ton trucks, 1 front end loader equipped with forklift, 1 John Deer 1010 tractor, and 1 International 500B tractor.

During the project the tractor proved inefficient for moving over the terrain and for hauling logs to the road. An inadequate supply of wood was cut at the beginning of the project because the market had not been confirmed; the advertising campaign was not extensive enough, and trucks used to haul the logs were not equipped to carry pallets, causing delays in the loading of logs at the site.

Schematic Diagram:



Energy, Mines and Resources Canada

Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Fish Oil as a Fuel

Fishery Products International Ltd.

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Gaultois

Project Manager:
David Neville, P. Eng.
Fishery Products
International Ltd.

Date:
August, 1985

Project Number:
03:04:22(2):42

Status:
Complete

Technology:
Renewable energy
(waste fuels)

Sector:
Industrial (Fish plant)

Province:
Newfoundland

Purpose:

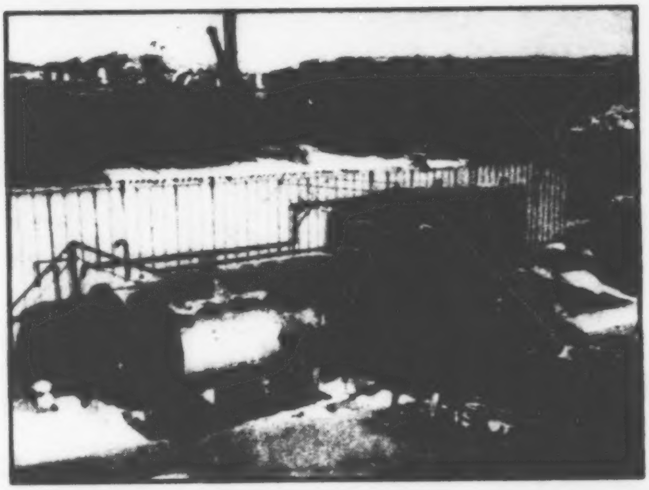
To demonstrate the use of fish oil as a replacement fuel to provide heat and steam in a fish plant.

Description:

A low pressure steam boiler system has been adapted to burn a mixture of fish oil and fuel oil which has been prepared in a special storage/mixing system. The low pressure steam is distributed to the fish processing area and the meal plant for processing and space heating.

Contributors:

Fishery Products International Ltd.	$ 5,633
Canada/Newfoundland	$10,500
Total	$16,133



Gaultois fish plant.

Expected Benefits/Savings:

By using a mixture of fish oil (40%) and No. 2 fuel (60%), fuel oil consumption was reduced from 1614 L per day to 968 L per day. The daily saving, including the cost of high oil was $50 per day, which reduced the energy bill by 12.8%.

Information Contact:

David Neville, P. Eng.
Fishery Products Int.
P. O. Box 550
O'Leary Avenue,
Newfoundland
A1C 5L1
Phone: (709) 754-0430

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

FISH OIL BURNER

Economic Analysis:

Project costs	
Capital	$ 9,889
Installation	$ 5,744
Total Installed Cost	$15,633
Monitoring	$ 500
Total Demonstration Cost	$16,133
Operating Costs	
Pre-Installation Cost	$117,150
Post-Installation Cost	$101,500
Net Savings	$ 15,050
Simple payback period:	1 year

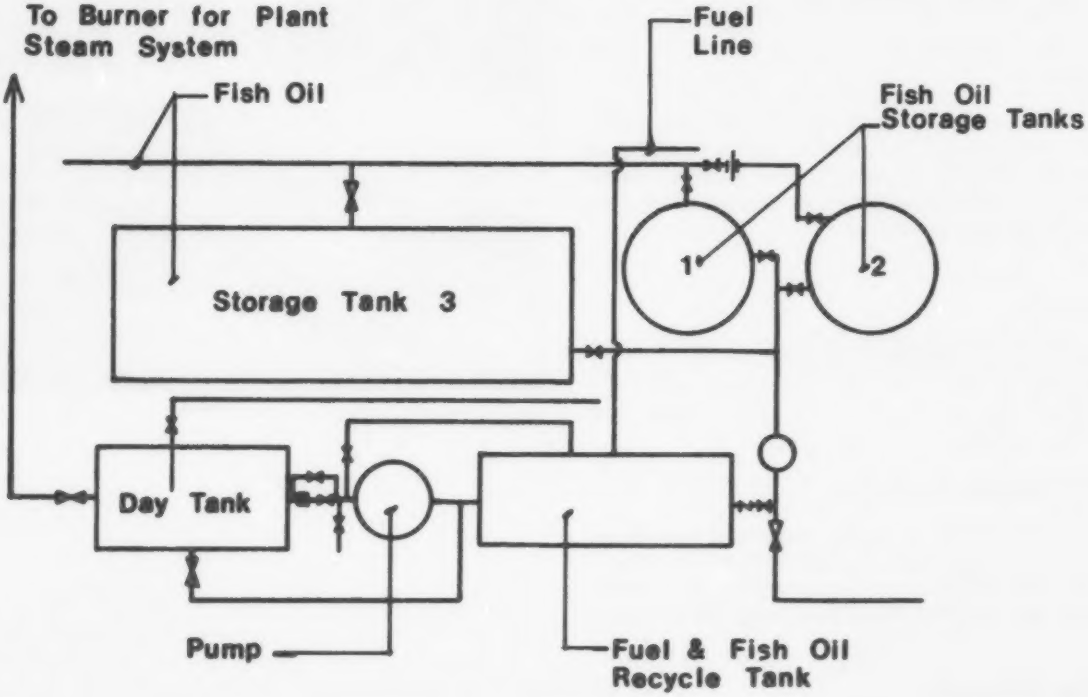
Monitoring Evaluation:

Daily records are being kept of exhaust stack temperatures, fuel consumption, carbon dioxide levels in exhaust gases and overall performance for one year.

Technical Details/Specifications:

Fish oil is separated from the offal and is stored in one of 3 storage tanks. It is then mixed 40:60 with No. 2 fuel oil. The mixture is burned in a low-pressure, 70 HP steam boiler.

Schematic Diagram of Fish Oil as a Fuel


To Burner for Plant Steam System
Fish Oil
Fuel Line
Fish Oil Storage Tanks
1
2
Storage Tank 3
Day Tank
Pump
Fuel & Fish Oil Recycle Tank

Energy, Mines and Resources Canada **Énergie, Mines et Ressources Canada**

Mines & Energy Newfoundland

Poultry Litter Burner
Howard Noel

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Noel's Poultry Farm
Howley, Newfoundland

Project Manager:
Howard Noel
Howley, Newfoundland
A0K 3E0

Date:
May, 1983

Project Number:
03:04:22:03

Status:
Completed

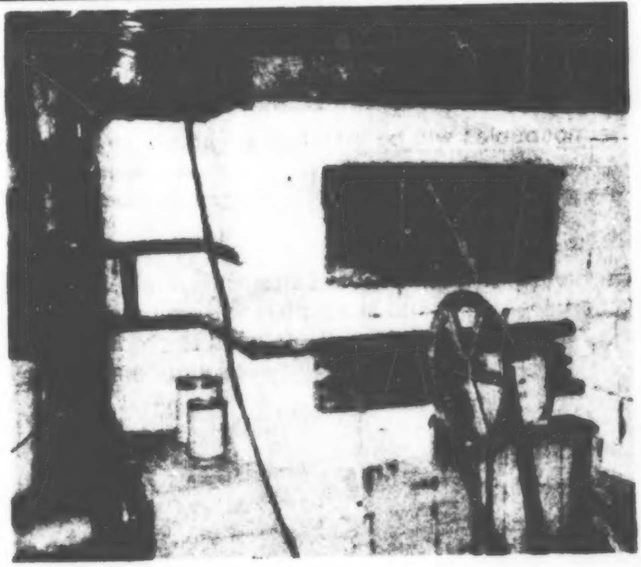
Technology:
Agricultural Waste

Sector:
Agriculture

Province:
Newfoundland

Purpose:

To demonstrate the benefits of converting a poultry house's heating system from fuel oil to poultry litter.



Description:

A litter fuel burner constructed by the owner and a purchased boiler have been installed in a new addition to the owner's barn. The chicken litter is augered into the burner from a new fuel storage shed.

Contributors:

Canada	(CREDA)	$7,200.00
Newfoundland	(CREDA)	1,800.00
Howard Noel		14,772.00
	Total	$23,772.00

Newfoundland Department of Rural, Agricultural and Northern Development provided engineering and technical services.

Expected Benefits/Savings:

The burner consumes an average of 25 kg of litter per hour, which is roughly equivalent to 13 L of fuel oil. The burner should operate for 2600 hours per year, resulting in a projected saving of 33,800 L of fuel oil annually minus 1,983 L required for oil start-up. Annual cost savings are estimated at $11,300.

Further Information:

A final report, a poster and a slide show will be produced.

Information Contact:

Howard Hoel
Project Manager
Howley, Newfoundland
A0K 2E0
Phone: (709) 635-2897

or Clarissa Dicks, Information Coordinator
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 737-2411

SMALL SCALE PROJECT

Project Name:

Poultry Litter Burner

Economic Analysis:

Project Costs:

Capital	$20,059.00
Installation	3,713.00
Total installed cost	$23,772.00
Monitoring	1,500.00
Total demonstration cost	$25,272.00

Operating Costs:

Pre-demonstration annual fuel cost (33,800 L oil @ $0.35/L)	$12,000.00
Post-demonstration annual fuel cost (1,983 L oil @ $0.35/L)	$700.00
Net annual fuel savings	$11,300.00

Simple Payback Period: 3 years

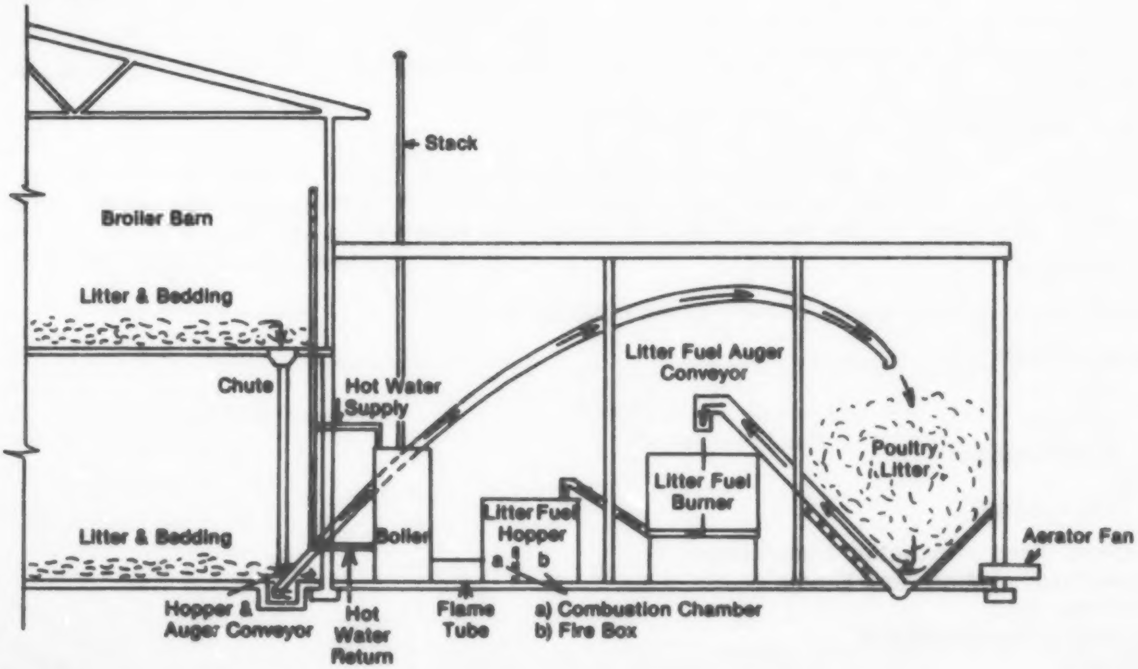
Monitoring/Evaluation:

Thermocouples will be installed at various strategic points in the flame chamber, flame tube funnel and other areas to monitor temperature on a digital readout system. Records will be kept of the fuel used, the need for back-up power and any noted changes in production performance.

Technical Details/Specifications:

The system consists of four parts: 1) a storage bin with screw conveyor, 2) a fire box and flame chamber unit, 3) a flame tube funnel and 4) a boiler. The average heating requirement for the barn is 230,000 BTU (242,850 kJ) per hour, although the burner is designed to produce more. It operates on the same principle as a wood or oil-fired furnace, with one exception: it needs sufficient air flow with high static pressure in the firebox to achieve effective fuel combustion.

Schematic Diagram:


Stack
Broiler Barn
Litter & Bedding
Chute
Hot Water Supply
Litter Fuel Auger Conveyor
Poultry Litter
Litter Fuel Burner
Litter Fuel Hopper
a
b
Boiler
Litter & Bedding
Aerator Fan
Hopper & Auger Conveyor
Hot Water Return
Flame Tube
a) Combustion Chamber
b) Fire Box

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Energie, Mines et Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Poultry Litter Burner
John Robinson

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Bellevue, Trinity Bay

Project Manager:
J. Robinson

Date
August, 1985

Project Number:
03:04:22:31
Status:
Completed

Technology:
Waste Fuel

Sector:
Agricultural
Province:
Newfoundland

Purpose:

To demonstrate the benefits of converting a poultry house heating system from fuel oil to poultry litter

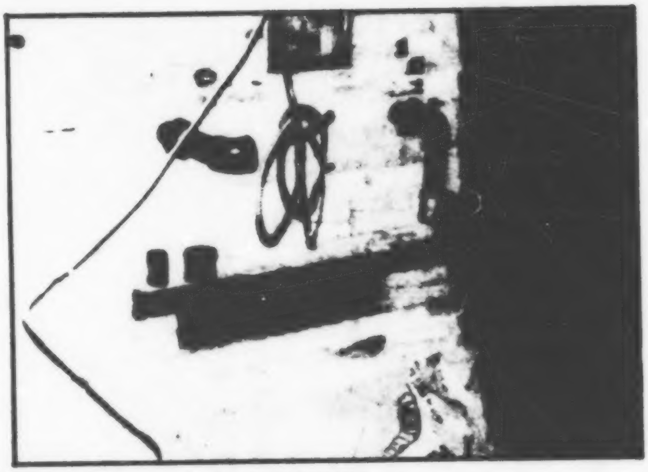
Contributors:

J. Robinson	$14,466
Canada/Newfoundland	$10,300
Total	$24,766

The Newfoundland Department of Rural, Agricultural and Northern Development provided engineering and technical services.

Demonstrated Benefits/Savings:

The litter replaces at least ninety per cent of the fuel oil previously consumed, approximately 35,000 L annually. The saving is therefore about 31,500 L, worth $12,600 in 1985.



The litter burner during construction.

Information Contact:

John Robinson
Doe Hills Farm
Bellevue, Trinity Bay
Newfoundland
Phone (709) 442-4211

or

Information Section
Energy Branch
Department of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone (709) 576-2411

SMALL SCALE PROJECT

POULTRY LITTER BURNER

Economic Analysis:

Project Costs

Capital	$18,000
Installation	$ 6,766
Total Project Cost	$24,766
Monitoring and Technology Transfer	$ 300
Total Demonstration Cost	$25,066

Operating Costs

Pre-installation	$14,000
Post-installation	$ 1,400
Net Savings	$12,600
Simple Payback	2.4 years

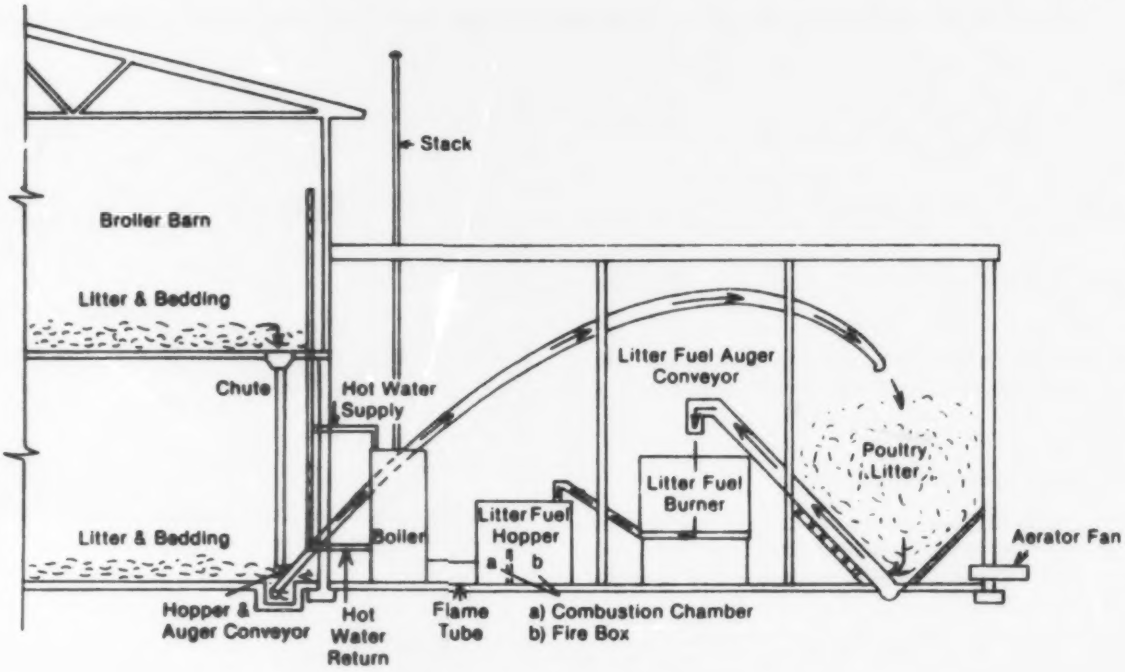
Monitoring/Evaluation

Fuel and electrical utility bills will be collected for a period of a year after completion. In addition, temperature measuring devices were installed in the firebox, fire chamber, and flame tube.

Technical Details/Specifications

The original heating system consisted of two 146 kW oil-fired boilers supplying a hot water distribution system. The boilers were replaced with a masonry litter burner, having four fuel outlets for even distribution of the fuel. The unit will consume up to 50 kg of mixed litter and bedding hourly. A variable air supply and two-speed auger for fuel allow full control of the combustion process.

The littler is usable in its raw state in this system, removing the need for drying or composting.


Stack
Broiler Barn
Litter & Bedding
Chute
Hot Water Supply
Litter Fuel Auger Conveyor
Poultry Litter
Litter Fuel Burner
Litter Fuel Hopper
Boiler
Litter & Bedding
a
b
Aerator Fan
Hopper & Auger Conveyor
Hot Water Return
Flame Tube
a) Combustion Chamber
b) Fire Box

Poultry Litter Burner

4.3.2 Project Applications

Of the six fuel projects funded, all except two are now complete. Table 3 (Page 31) shows a list of the proponents, project costs, payback periods, and types of fuel used. The capital costs of these projects range from approximately $7,000 to $24,000. The payback periods range from 8 months to three years which is by far the most impressive for any of the groups of projects demonstrated.

4.3.3 Observations

All of the completed waste fuel projects appear to be operating properly. Complete monitoring data is not available for some projects, however estimates of fuel savings and payback periods reasonably reflect what might happen during a full year of operation.

4.3.3.1 Waste Wood Burner

Mr. and Mrs. G. Van Koetsveld have installed the heating and heat storage apparatus (HAHSA) to provide heat for a small commercial greenhouse. The unit is operating very well and is providing an ample supply of heat for the greenhouse.

The operation of the HAHSA wood burning unit is quite simple. A woodburning fire box is surrounded by more than 18 tons of sand. This sand acts as a thermal mass for storing and releasing heat. As the wood burns, the thermal mass heats up and the heat is transferred to a system of pipes via heat exchangers buried in the sand.

4.3.3.1 Waste Wood Burner (Cont'd)

These pipes contain water which then heats up and is circulated to the greenhouse to supply heat. The unit is designed to burn almost any form of wood. Wood slabs, logs, wood chips and other pieces of scrap wood can be readily burned to create heat.

This system is proving to be an excellent source of inexpensive heat energy. It definitely has many commercial and domestic applications and could eventually be adapted to a large scale basis if properly promoted.

4.3.3.2 Waste Wood Collection/Distribution System

Mr. L. Collins in Hare Bay set up a company to recover waste wood from forest fire damaged wood stands. His harvesting system efficiently cuts, hauls, stockpiles, and sells the wood.

The savings in this project are to the Federal Government. When consumers use the wood as a fuel, the Federal Government saves money on the Federal oil subsidy. The government funded $10,000 while Mr. Collins supplied $7,067 to harvest the wood. The wood was then sold at prices reflecting the Federal subsidy.

The following year, there was no government money for Mr. Collins and as a result he had to sell the wood at a higher price. The market was not there for high priced wood and as a result, his harvesting company no longer exists.

4.3.3.3 Waste Oil Burner

The waste oil burner at Harvey and Co. Ltd. has never been in operation due to environmental problems. A lack of communications between Harvey's Oil, the Department of Mines & Energy and the Newfoundland Department of Environment allowed this project to be funded despite the environmental restrictions. The Department of Environment requires that lead free oil be used in the waste oil burner to ensure that there is no lead emmisions released to the atmosphere. Because of this restriction the company has decided to put the project on hold for the present time.

4.3.3.4 Fish Oil Burner

Fishery Products Limited has adapted their low pressure steam boiler system at the Gaultois fish plant to burn a mixture of 40% fish oil and 60% #2 fuel oil. Fish oil is a byproduct of the processing plant so it is readily available to the fish plant. A fuel storage mixing system has been installed at the plant.

The unit should operate very well and is projected to save the company $15,000 per year on heating costs and has a payback period of one year once it is installed.

4.3.3.5 Chicken Litter

There were two chicken litter burners funded under the Small Scale Energy Demonstration Project only one of which is completed at the writing of this report at this time.

4.3.3.5 Chicken Litter (Cont'd)

Mr. H. Noel has installed one on his farm in Howley and it was operating very well as far as energy was concerned (providing him with $11,300 savings annually). However Mr. Noel eventually abandoned the original design because of the high labour costs involved in tri-weekly cleanout of the heat exchanger. He has designed a new system and is installing it in August 1985.

The status of the second chicken litter project is that Mr. J. Robinson has nearly completed his burner should be completed in June 1985.

The basic operation of both of these burner systems is similar. Chicken litter and bedding is collected from the broiler, transported via a hopper and auger conveyer, stored and dryed, then transported via a conveyor to the furnace. The hot air furnace burns the fuel and the hot air is distributed to the chicken barn via ductwork.

Mr. Noel's heating requirements are easily met by his burner system. He uses a small amount of oil, 2,000 litres annually, for startup. The chicken litter provides all the fuel necessary for heating requirements. Once Mr. Robinson has his system operational, it is probable that his system would also provide the heat that his chicken barn requires.

4.3.3.5 Chicken Litter (Cont'd)

Farm biomass burners are a new technology in Newfoundland. The capital costs of these projects are high making them difficult to construct for many of the farmers. However, since the payback periods are so short, they are a very attractive investment. This technology should be more fully explored in Newfoundland because of its great potential as a renewable energy source.

4.3.4 Cost/Benefit Analysis

Waste fuel technologies have proven to be one of the better demonstration projects under the Small Scale Energy Demonstration Program. Project costs were high ranging from approximately $7,000 to $24,000 but the payback periods were small with the maximum being 3 years. Waste fuel technologies are the most economically feasible groups of projects because of the low cost of waste fuel. Waste fuel sources were always by-products of manufacturing processes and as a result were often discarded. A low cost, sufficient supply of waste fuel is essential to ensure a favourable return on this type of investment.

4.3.5 Conclusions

Because of the tremendous potential for energy substitution/displacement, waste fuel retrofit projects should be encouraged. There are many sources of waste fuel across the province but most of them are being discarded. Where the fuel is

4.3.5 Conclusions (Cont'd)

available, it is unwise to let it go to waste. By using waste fuel burners many small commercial establishments such as some farms and fish plants, may be able to reduce operating costs, and increase profits.

4.3.6 Recommendations

All of the waste fuel projects demonstrate potential for considerable savings. Although the capital costs are fairly high, short payback periods make these investments attractive.

There were only two projects which were incomplete. These were: (1) the waste oil burner of Harvey & Co. Ltd. and (2) the chicken litter burner owned by Mr. Robinson. Listed below are some recommendations which might help prevent similar situations from reoccuring in future demonstration programs.

(1) Better communication and confirmation in writing where operational standards are unclear. If Harvey & Co. Ltd. had obtained written confirmation of the acceptability of the waste oil burner, they would have known much sooner of the requirements of the Department of Environments.

(2) The creation of project schedules and a strict adherence to the timing should be enforced. The proponents should be encouraged

(2) (Cont'd)

through an incentive system to meet the project schedule, then except for extenuating circumstances, all the projects would be completed on time. Perhaps a financial penalty could be imposed on the proponents if for no justifiable reason the projects fall grossly behind schedule.

The overall success of this type of project leads to the replication of similar projects in other communities. The following are three recommendations which would improve the replication of waste fuel projects in the province.

(3) 1. **Technology Transfer**

The success of these projects should be communicated to other people in the small commercial sector who would most benefit from these types of projects. All animal farms produce biomass, all garages collect oil, and all sawmills produce wood waste but most of this is not being utilized. A serious effort can be made to make people aware of the potential of these waste fuels.

2. **Financial Assistance**

Because of the capital costs of these projects can be high, some kind of grant or short term financing should be made available to the people and businesses interested in installing waste fuel systems. Most farmers and fish plant owners presently

(3) (Cont'd)

do not have the money they need to construct these systems. By making available to these people capital assistance for these projects, production costs can at least be maintained and profitability can rise.

3. Alternative Waste Fuel Demonstrations

Encouragement should be given to other waste fuel projects. Noticably missing from waste fuel systems was a system to burn waste paper. Thousands of tons of paper are thrown out each year by large commercial and government office buildings. This paper could be used to provide space heating or to run steam turbines to generate electricity.

There is a large potential for waste fuel technologies in Newfoundland. These technologies should be pursued vigorously in an effort to utilize this alternative source of energy.

TABLE 3

WASTE FUEL PROJECTS

PROPONENT	PROJECT COST	PAYBACK PERIOD	TYPE OF FUEL
G. & L. Van Koetsveld	$ 6,925	2.5 years	Waste Wood
L. Collins	$17,077	8 months	Waste Wood
Harvey & Co. Ltd.	$13,200*	1.6 years **	Waste Oil
Fishery Products Inter'l	$15,633	1.0 year	Fish Oil
H. Noel	$23,772	3.0 years	Chicken Litter
J. Robinson	$24,766***	2.4 years	Chicken Litter

* Project Estimated Installed Cost - Project not implemented because of environmental reason - (see text)
** Projected Savings
*** Project Not Complete

5.0 ENERGY CONSERVATION TECHNOLOGIES INTRODUCTION

Energy conservation technologies reduce the total amount of energy consumed by a building or process. By using effective energy conservation techniques such as insulating to the latest standards or by operating a building or process in a more efficient manner, the total energy consumption can be significantly reduced. The next three subsections describe eacn of the technologies of energy conservation.

5.1 Energy Efficient Construction

5.1.1 Description

By constructing buildings which are energy efficient through the use of properly insulated ceilings, walls, and doors as well as shuttered double glazed windows and air/vapour barriers, energy consumption can be reduced to a very reasonable level. It is best to incorporate these designs into a new building rather than retrofit the building after construction because of the high capital costs of renovation work. However, improving weatherstripping and adding insulation to ceilings can usually be done at any time.

There were four different types of technologies with 5 projects funded under the Small Scale Energy Demonstration Program. These were (1) 2 sunspaces, (2) energy efficient home, (3) refrigerant pipe insulation and (4) a trombe wall.

Energy, Mines and Resources Canada

Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Sunspace
Dale Sudom

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Paradise

Project Manager:
Dale Sudom
Paradise

Date:
March, 1985

Project Number:
03:04:22(2):54

Status:
Complete

Technology:
Passive Solar Heating/
Alternate fuels

Sector:
Residential

Province:
Newfoundland & Labrador

Purpose:

To use a sunspace adjoined to a dwelling to store and recover solar energy to augment the heating system, and to demonstrate the related savings of such a design.

Description:

A single glazed prefabricated sunspace has been installed on the southside of the house. Forced air is circulated from the top of the greenhouse to the house and/or through an insulated rock bin. Incident solar radiation is stored by the thermal mass in the rockbin and concrete floor and is then released at night as passive heat.

Contributors:

D. Sudom	$4,360
Canada/Newfoundland	$2,300
Total	$6,660

Demonstrated Benefits/Savings:

In general sunspaces are not cost-effective from an energy savings point of view but may be practical if combined with other uses (growing plants etc.)

Information Contact:

Dale Sudom
Box 21, Site 7, RR2
Paradise, Newfoundland
A0A 2E0
(709) 773-1336

or

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland A1C 5T7
(709) 576-2411

The Sunspace

SMALL SCALE PROJECT

PASSIVE SOLAR SUNSPACE

Economic Analysis:

Project Cost

Capital	$5,480
Installation	880
Total Installed Cost	$6,360
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$6,660

Operating Costs

Pre Demonstration	$1,800
Post Demonstration	$1,600
Net Savings	$ 200
Simple Payback Period:	32 yrs.

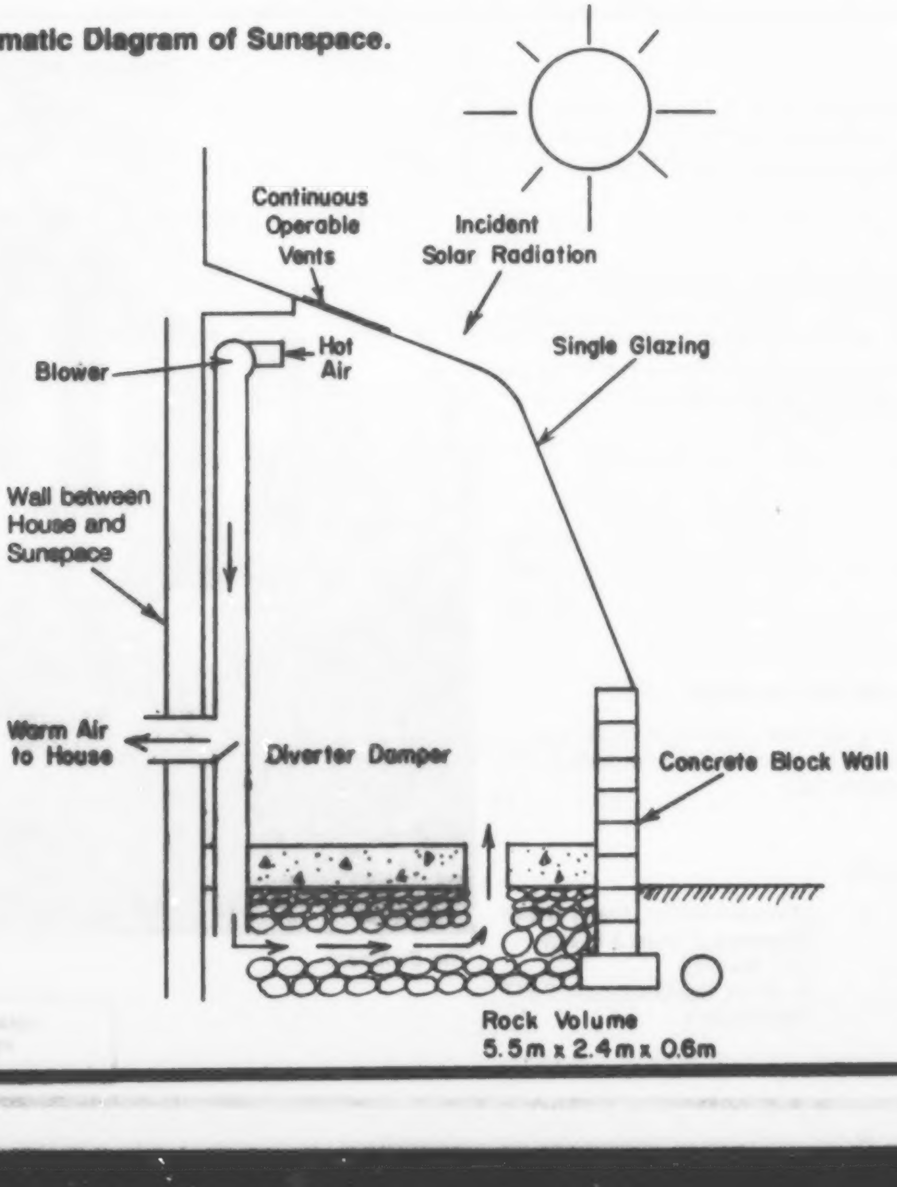
This information is based upon a partial season's data.

Monitoring Evaluation:

The owner is recording maximum and minimum temperatures in the room adjacent to the greenhouse, outside air temperatures, greenhouse air temperatures, and rockbin temperatures and is monitoring the use of the vents to the greenhouse.

Technical Details/Specifications:

The thermal mass of the rockbin stores heat from incident solar radiation and air circulated through it during the day. At night this radiation is released as passive heat. When the sun shines, the temperature inside the sunspace rises considerably. This trapped heat is then used to heat the rest of the house. The sunspace construction features a large rock and concrete thermal mass, single glazing with an aluminum frame, and ductwork with a blower system activated by a thermostat. Hot air from the greenhouse can be circulated to the house and/or to the rockbin by adjusting a damper.



Schematic Diagram of Sunspace.

Continuous Operable Vents
Incident Solar Radiation
Hot Air
Blower
Single Glazing
Wall between House and Sunspace
Warm Air to House
Diverter Damper
Concrete Block Wall
Rock Volume
5.5m x 2.4m x 0.6m

Energy, Mines and
Resources Canada

Energie, Mines et
Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Passive Solar Sunspace
Joan Tucker

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Paradise

Project Manager:
Joan Tucker

Date:
August, 1985

Project Number:
03:04:22(2):43

Status:
Complete

Technology:
Passive Solar Heating

Sector:
Residential

Province:
Newfoundland

Purpose:

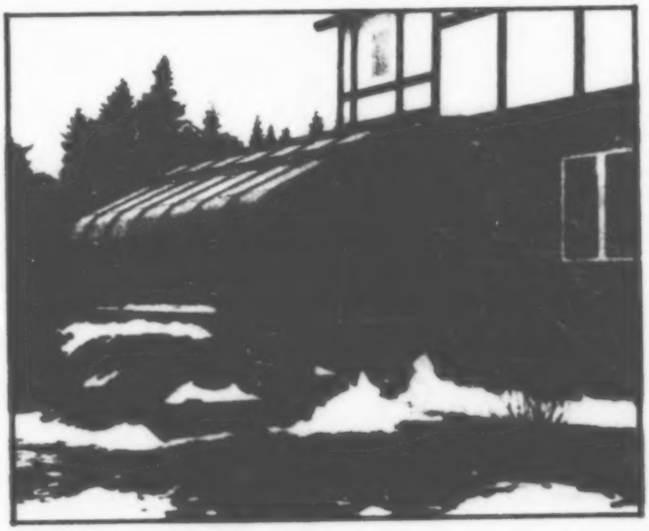
To use a sunspace adjoined to a dwelling to store and recover solar energy to augment the heating system, and to demonstrate the related savings of such a design.

Description:

A single glazed prefabricated sunspace has been installed on the southside of the house. Air is circulated from the house through the sunspace and back to the house by opening windows in the wall between the sunspace and the house. Stored heat is recovered during cloudy periods or at night. The sunspace is not heated by any other means.

Contributors:

E & J Tucker	$ 8,000
Canada/Newfoundland	$ 2,600
Total	$10,600



The sunspace exterior.

Demonstrated Benefits/Savings:

This design does not offer a reasonable payback because of the lack of double glazing.

Further Information:

Information Contact:

Edmund or Joan Tucker
Box 17, Site 3, RR1
Paradise, Newfoundland
Phone: (709) 895-6418
A0A 2E0

or

Information Section
Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

PASSIVE SOLAR SUNSPACE

Economic Analysis:

Project Costs	
Capital	$ 7,500
Installation	$ 3,000
Total Installed	$10,500
Monitoring & Technology Transfer	$ 100
Total Demonstration Cost	$10,600
Operating Costs	
Pre Demonstration	$ 1,500
Post Demonstration	$ 1,290
Net Savings	$ 210
Simple Payback Period	50 yrs.

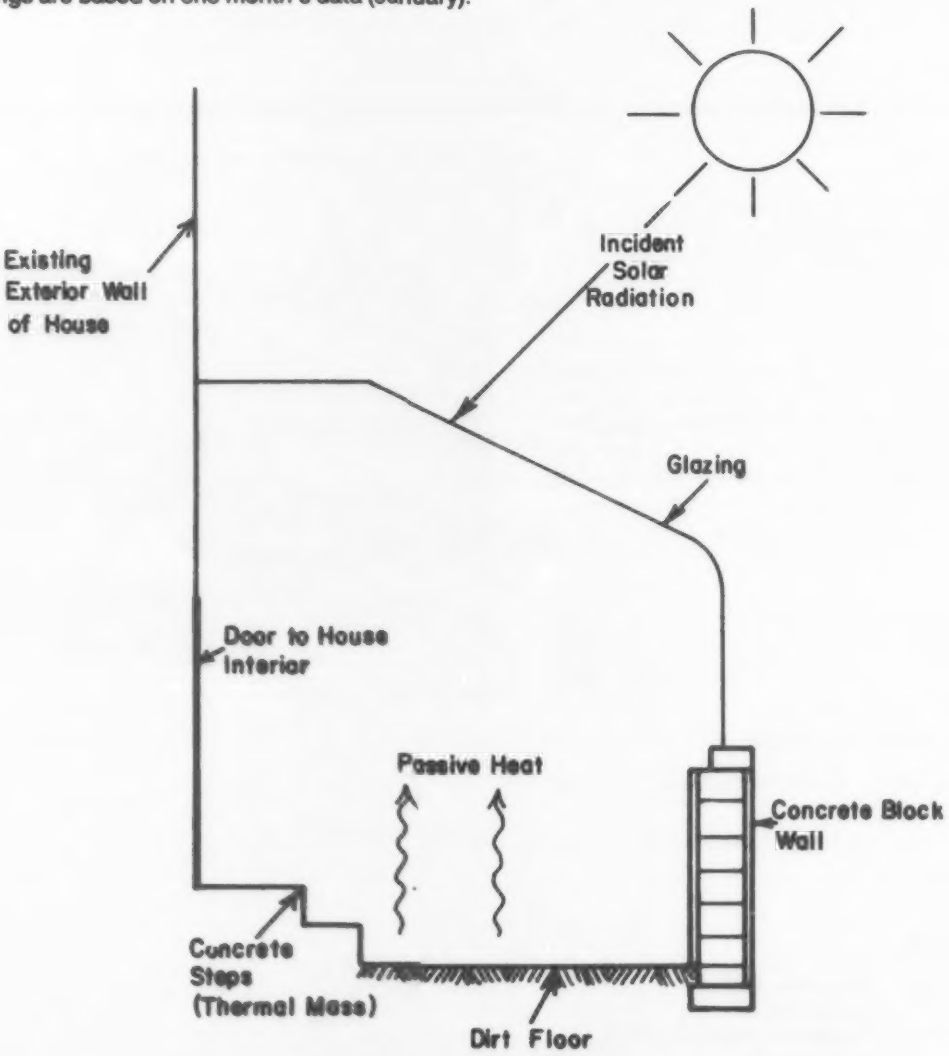
Note: Net Savings are based on one month's data (January).

Monitoring Evaluation:

The owner is recording maximum and minimum temperatures in the sunspace and outside. Also kWh meter readings are being recorded of the total energy consumed by the combined house and sunspace.

Technical Details/Specifications:

The thermal mass of the 4.9 m by 2.7 m sunspace stores heat from incident solar radiation during the day. At night this radiation is released as passive heat. When the sun shines, the temperature inside the sunspace rises considerably. This trapped heat is then used to heat the rest of the house. The sunspace construction features a large concrete floor and knee wall, and single glazing with an aluminum frame.


Existing Exterior Wall of House
Incident Solar Radiation
Glazing
Door to House Interior
Passive Heat
Concrete Block Wall
Concrete Steps (Thermal Mass)
Dirt Floor

Passive Solar Sunspace

Energy-Efficient New Home

Paul Shoemaker

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Curzon Village
Bonne Bay

Project Manager:
Paul Shoemaker

Date:
August, 1985

Project Number:
03:04:22:21

Status:
Complete

Technology:
Conservation

Sector:
Residential

Province:
Newfoundland

Purpose:

To demonstrate energy-efficient new house construction.

Description:

The proponent constructed an energy efficient house, which includes extra insulation, insulated shutters and a no-energy food storage unit (larder).

Contributors:

Canada/Newfoundland	$1,728
Paul Shoemaker	$1,627
Total	$3,355

Expected Benefits/Savings:

The energy conserving features resulted in the annual energy costs of this home being $350 lower than those of a comparable standard built home.

Mr. Shoemaker's house.

Information Contact:

Paul Shoemaker
P. O. Box 42
Woody Point
Bonne Bay, Nfld.
A0K 1P0
Phone: (709) 453-7270

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

SMALL SCALE PROJECT

ENERGY-EFFICIENT NEW HOME

Economic Analysis:

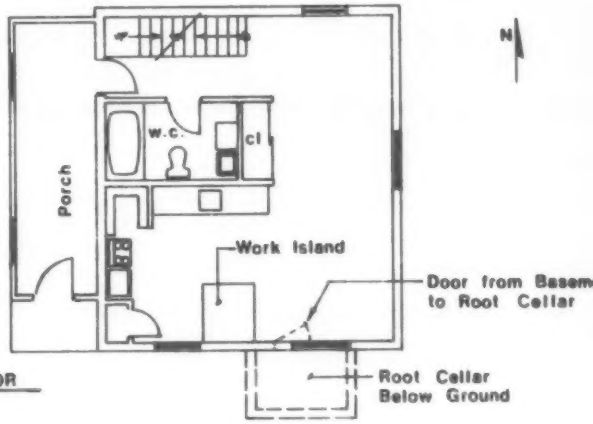
Total demonstration cost (includes labour and materials no monitoring cost)	$3,355
Operating Costs	
Standard-built comparable house (heat & light)	$ 870
Energy-efficient house (heat & light)	$ 520
Net annual fuel savings	$ 350
Simple Payback Period	9.6 years

Monitoring/Evaluation:

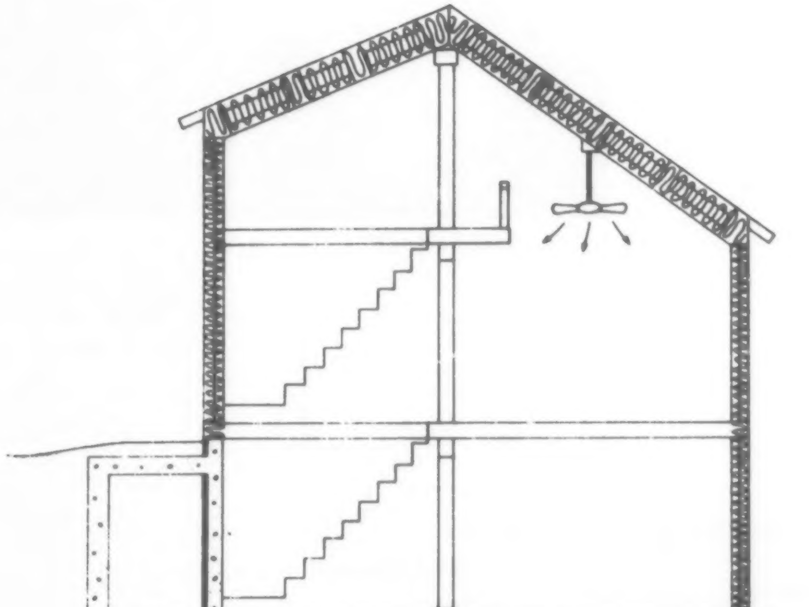
The proponent has kept fuel consumption records for wood and electricity. The larder and cellar temperatures were also monitored.

Technical Details/Specifications:

The 150m² house features a double wall construction technique to give the walls an RSI 4.9 value. The ceiling has an RSI 7.0 value using fibreglass batts, and the basement walls have RSI 1.42 Styrofoam insulation on the outside. All windows have shutters constructed of plywood, 49 mm Styrofoam and weatherstripping. The outside doors are similarly constructed. The larder is an insulated room at the north side of the house, where perishable foodstuffs are stored. The larder acts as a refrigerator. A root cellar houses fruits and vegetables for winter storage.



FIRST FLOOR



EAST ELEVATION

Energy, Mines and Resources Canada

Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Brine Pipe Insulation

Humber Gardens Arena

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Humber Gardens Arena
Corner Brook

Project Manager:
Mr. J. Warford, P. Eng.
Corner Brook

Date:
March, 1985

Project Number:
03:04:222:46

Status:
Completed

Technology:
Energy Conservation
by Insulation

Sector:
Recréation (Ice Arena)

Province:
Newfoundland & Labrador

Purpose:

To demonstrate that pipe insulation in a typical arena can reduce energy costs.

Description:

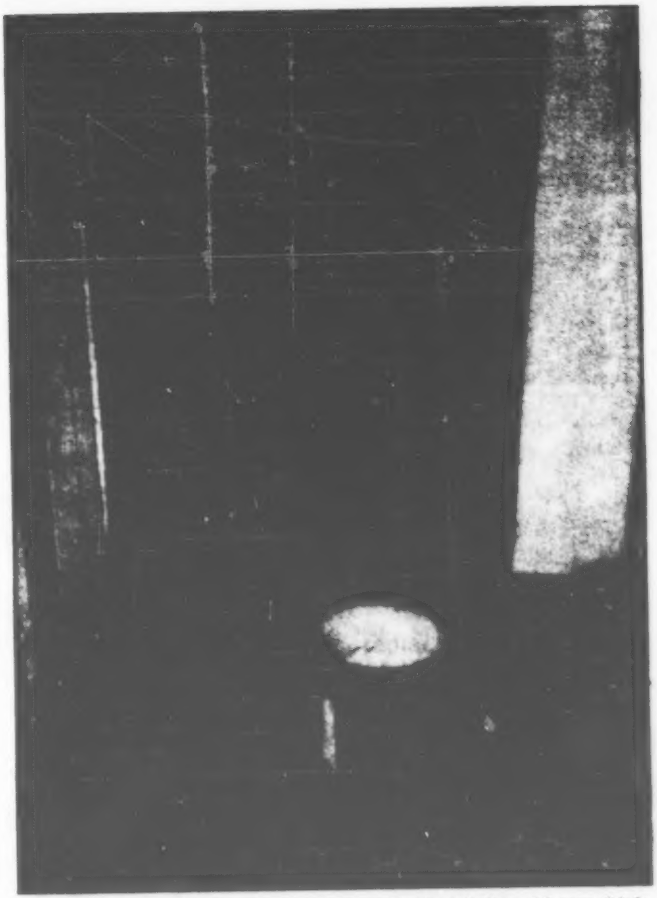
The system consists of 50 mm thick urethane pipe insulation with aluminum foil vapour barrier on the outside and kraft paper inside, applied to 61 metres of bare pipe which is in a heated area of the arena.

Contributors:

City of Corner Brook	$1,446
Canada/Newfoundland	$3,009
Total	$4,455

Demonstrated Benefits/Savings:

The arena has saved $730 or 1% of the original heat loss through the entire piping system annually.



Placing 150 mm preformed urethane pipe insulation, 50 mm thick, round the brine pipe.

Information Contact:

Mr. J. Warford, P.Eng.
City of Corner Brook
P. O. Box 1080
Corner Brook, Newfoundland
A2H 6E1
(709) 634-8291

or

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

BRINE PIPE INSULATION

Economic Analysis:

Project Costs

Capital	$ 3,000
Installation	$ 1,155
Total Installed Cost	$4,155
Monitoring and Technology Transfer	$ 300
Total Demonstration Cost	$ 4,455

Operating Costs (Estimated)

Pre Demonstration	$88,000
Post Demonstration	$87,270
Net Savings	$ 730

Simple Payback Period:	5.7 years

Monitoring Evaluation:

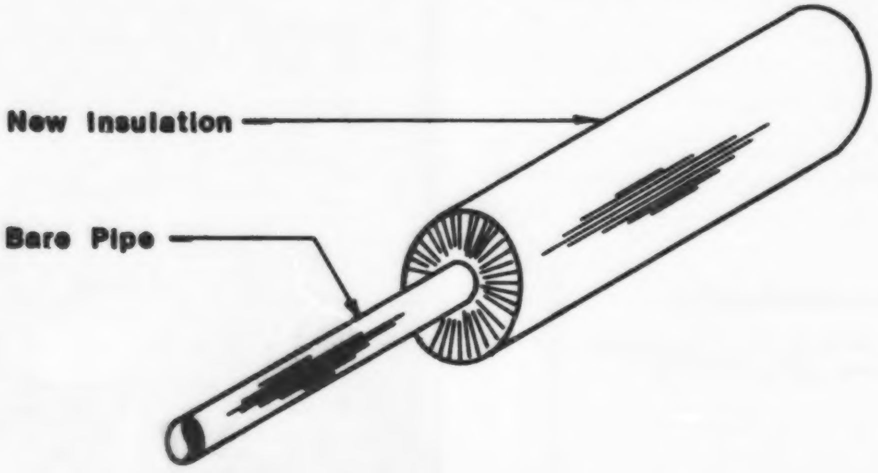
The arena staff measured the following items after the insulation was installed:

1) Brine temperature
2) Pipe surface temperature
3) Insulation surface temperature
4) Room temperature

Technical Details/Specifications:

The pipe insulation chosen, manufactured in Newfoundland by Trico, is specifically designed for refrigeration applications.

Schematic Diagram of Brine Pipe Insulation



Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

Mines & Energy Newfoundland

Trombe Walls
C. A. Pippy Park Scout/ Guide Campsite Committee

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
C. A. Pippy Park
Nagles Hill, St. John's
Newfoundland

Project Manager:
Mike Manning
C. A. Pippy Park Commission
Box 8861, 79 Nagle's Hill

Date:
May, 1983

Project Number:
03:04:22:11

Status:
80% Complete

Technology:
Solar Heating - Passive

Sector:
Residential

Province:
Newfoundland

Purpose:

To demonstrate an alternative energy heating system consisting of a trombe wall and a wood stove in each of two cordwood chalets used by Girl Guides and Boy Scouts from April to October.

Description:

A masonry wall with an outer Kalwall will be incorporated into the south face of each chalet to collect and store solar energy which will later be radiated into the building as heat. Auxiliary heat will be provided by a woodstove. Fuel comes from wind-damaged and fallen trees located on the campgrounds.

Contributors:

Canada	(CREDA)	$2,323.00
Newfoundland	(CREDA)	581.00
C. A. Pippy Park Girl Guide-Boy Scout Committee and Katimavik		700.00
	Total	$3,604.00

Expected Benefits/Savings:

The trombe wall is expected to provide 40% of each chalet's heating requirements, replacing an estimated 1,133 L of fuel oil during seasonal operation for a total cost saving of $397.00. The wood stoves will consume an estimated 18 m^3 of wood per year at no cost, resulting in estimated energy savings of 1700 L of fuel oil and cost savings of $595.00.

Further Information:

A final report will be available in September, 1983. A poster will also be produced.

Information Contact:

Mike Manning
C. A. Pippy Park Commission
Box 8861, 79 Nagles Hill
St. John's, Newfoundland A1B 3T2
Phone: (709) 737-3655

or

Clarissa Dicks, Information Coordinator
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 737-2411

SMALL SCALE PROJECT

Project Name:

Trombe Walls

Economic Analysis:

Project Costs:

Capital	$2,904.00
Installation	700.00
Total installed cost	$3,604.00

Operating Costs:

Pre-demonstration fuel cost (2,833 L @ $0.35/L)	$992.00
Expected post-demonstration fuel cost (solar and fuelwood)	.00
Net annual savings	$992.00

Simple Payback Period: 3-1/2 years

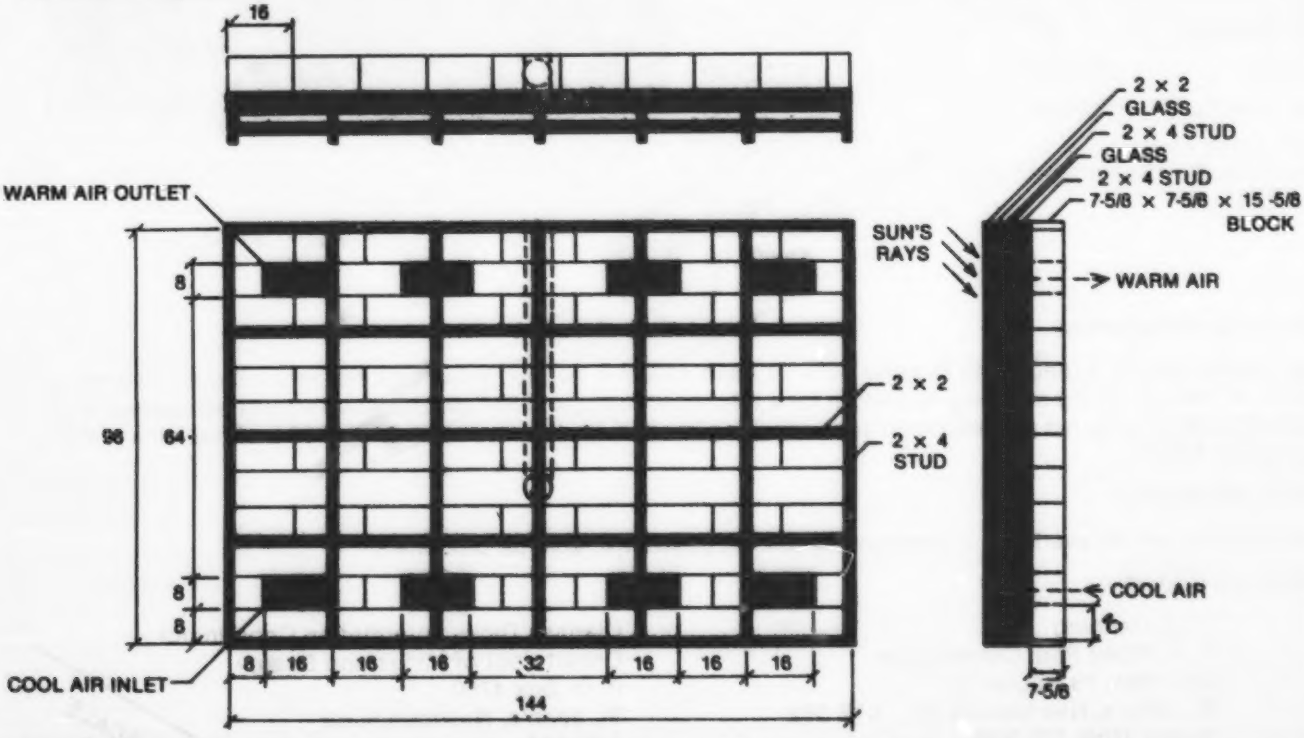
Monitoring/Evaluation:

Wood consumption will be monitored during the 1983 operating season.

Technical Details/Specifications:

The trombe walls are 8.9 m^2 and are constructed of concrete blocks (200 mm x 400 mm). A 4 mil Kalwall is placed on the 50 mm x 100 mm studs located at 400 mm centers. These studs are attached to the trombe wall. A second stud framing system and Kalwall is placed over the first. The trombe wall has intake vents to draw in the cool air at the bottom of the chalet. This air is heated by the sun inside the Kalwall. Vents located at the top of the wall allow warm air to return to the building. The wall also serves as a thermal storage system. It absorbs heat from the sun as well as from the wood stove during the day and radiates that heat into the building at night or during cloudy periods. The wood stoves are located just inside the trombe wall. The stove pipes run through the trombe wall to contribute to the stored heat.

Schematic Diagram:


16
WARM AIR OUTLET
8
96
64
8
8
COOL AIR INLET
8
16
16
16
32
16
16
16
144
2 × 2
2 × 4
STUD
SUN'S
RAYS
2 × 2
GLASS
2 × 4 STUD
GLASS
2 × 4 STUD
7-5/8 × 7-5/8 × 15-5/8
BLOCK
WARM AIR
COOL AIR
6
7-5/8

5.1.2 Project Applications

All of these five funded projects are now complete. Table 4 (Page 41) shows a list of the proponents, project costs, payback periods, and applications. The capital costs of these projects range from \$3,355 to \$6,990. The payback periods ranged from five years to fifty or more years. One particular project, the Girl Guides/Boy Scout Trombe wall has no monitoring data and the energy savings due to the trombe wall are minimal.

5.1.3 Observations

Although all the energy efficient construction projects have been completed, the energy savings of some of these projects is questionable. The trombe wall was installed at a cost of \$3,604 and does not seem to add to the energy efficiency of the structure. The solariums constructed do not provide any extra energy averaged over a year for the homes to which they are adjacent. They are simply an energy efficient addition to an existing dwelling. This fact is confirmed by the very high payback periods of these projects.

The brine pipe insulation and the energy efficient house are the two projects which do operate efficiently and they are providing a very reasonable return on the investment.

5.1.3.1 Sunspace

The Small Scale Energy Demonstration Program funded two sunspace projects, one is owned by D. Sudom, the other by Mr. E. Tucker. The operation of these sunspaces is simple.

During the day, heat is absorbed in a large thermal mass and then released to the space. A ventilation system should be provided to blow air through the thermal mass and back into the house but only Mr. Sudom's sunspace has a blower powered ventilation system with proper ductwork. Mr. Tucker's system simply uses windows between the house and the sunspace as a simple heat transfer mechanism to retreive the heat.

In neither case does the trapped heat contribute very significantly to the overall heating costs of the house. For the money spent on each of the projects the returns are definitely minimal. However, each proponent did make a considerable addition to their house and presumably did increase the house's market value without incurring additional heating costs. Mr. Sudom's sunspace, through proper design, has allowed him to extend his gardening season an additional 4 - 8 weeks in total. He has noted that there was no frost in the sunspace until the middle of December i.e. the temperature was above 0°C which is a testimony to the effectiveness of the thermal mass under the sunspace. Further improvements can be achieved by adding light insulation or another pane of glazing to the sunspace.

5.1.3.2 Energy Efficient House

Mr. P. Shoemaker constructed a 150 m2 energy efficient house which reduces his energy bills significantly when compared to a similar home built using standard construction techniques.

The walls of his home have a double wall construction which gives it a total RSI value of 4.93 (R26). The ceiling has RSI 7.04 (R40) fiberglass batts and his basement walls have RSI 1.41 (R8) styrofoam insulation. Mr. Shoemaker has used insulated doors and has installed insulated shutters over the windows. Also, Mr. Shoemaker has built a no energy food storage unit or larder. This is an insulated room on the North side with vents to outdoors. It is used to store fruit and vegetables during the winter months.

This project is operating very well and Mr. Shoemaker is now paying $520 annually for heat and lights. The energy efficient features have a low payback period because they were incorporated into the design of the home before it was built. Had this project been done as a retrofit, the capital costs would have been much higher.

This project should be used as a model of how well energy efficient construction can work on new housing. While the larder may not be as convenient as a refrigerator and therefore may not be a popular unit, the heavy insulation and shuttered windows may prove to be very popular and cost effective.

5.1.3.3 Refrigerant Pipe Insulation

The Humber Gardens Arena uses a brine refrigeration system to produce ice on its skating rinks. Before the retrofit, this refrigerant was circulated through uninsulated pipes. Heat from the surrounding air heated the brine which created a large parasitic load on the refrigeration system. Now, the pipes are insulated in the areas where they pass through heated areas and operational costs have been lowered by approximately $700 annually.

This project was part of several major retrofits which were funded at the Humber Gardens Arena. This particular project included the brine pipe insulation and power factor improvement. The power factor improvement is discussed in the Energy Management and Controls Section. The other project is a hot gas heat recovery which is discussed in the Heat Recovery Section.

This particular retrofit is an efficient energy conservation measure with a payback of 5.8 years. The annual savings of $700 represents only 1% of the total energy costs, however this was still a very good investment and should be considered for other areas with similar refrigeration systems.

5.1.3.4 Trombe Wall

The C.A. Pippy Park Girl Guide and Boy Scout Committees have constructed a trombe wall in each of the two wooden chalets used by them for seasonal camping. The operation of the trombe wall is straight forward. A thermal mass is heated by the sun and through convection heats up trapped air behind it. This warmed air is then circulated back into the building to heat the room.

It is impossible to obtain accurate data on the operation of these particular trombe walls. The principle function of the chalets is to act as shelters during rainy or windy nights when the campers cannot sleep in tents. None of the groups that go into the campsite take any energy consumption records. To prevent vandalism both chalets have shutters over the fiberglass portion of the trombe walls to prevent vandalism. These shutters must be removed for the trombe walls to operate properly, however they are very rarely removed. Also, from the information available it is understood that the trombe walls face towards the West rather than the South which would mean that the exposure is not at the optimum angle.

5.1.2.4 Trombe Wall (Cont'd)

The operation of a trombe wall can be successful if it is constructed and operated properly. It is not economically feasible to construct a trombe wall that has a Westerly exposure and that is not operated properly. It appears that the $3,604 spent on this project could have been better utilized elsewhere.

5.1.4 Cost/Benefit Analysis

Energy efficiency is something that every building owner should consider when preparing a design. When constructing a new building it would be economically unwise not to use energy efficient construction techniques. Retrofit costs to make buildings energy efficient are much higher when compared to building in the same features during the initial construction phase.

Depending on the type of feature the paybacks can be between 5 and 8 years for retrofits but can be less than 5 years as a new feature. Energy efficient construction whether in a new design or retrofit can help substantially reduce energy consumption and help save the owner a great deal of money.

5.1.5 Conclusions

Only two out of the five projects funded showed significant savings by implementing energy efficient construction. Although the two sunspaces were constructed using energy efficient techniques they did not reduce the total consumption of the house to which they were attached, which was their primary aim. However, they did not increase the energy consumption of the building and presumably did add to the marketability of the house.

The trombe wall installed by the Girl Guides and Boy Scouts did not yield the savings that were estimated. In Newfoundland, with the poor climatic conditions and relatively few bright sunshine hours, trombe walls are not practical. However, in other parts of Canada, properly constructed and operated trombe walls have proven to be very effective in trapping and transferring heat making them a economically feasible investment.

After having reviewed all of the energy efficient construction projects, one fact stands out more than anything else. It is far better to incorporate energy efficient construction into the initial construction of the building rather than retrofit the building at a later date. However, this should not discourage building owners from retrofitting their buildings when energy consumption can be greatly reduced.

5.1.6 Recommendations

Energy efficient construction projects showed varying degrees of success. The following recommendations should help ensure that future projects are more successful.

(1) Careful screening of projects and their potential savings should be conducted. With a small amount of research it would have been obvious that the Trombe wall would not have been successful for that particular application. Also, the sunspaces would not have been funded because they did not meet the requirements of reducing the overall energy consumption.

(2) The success of the project at Humber Gardens and of Mr. Shoemaker's House should be emphasized. This would show the feasibility of proper insulation and energy efficient construction techniques.

(3) An effort should be made to inform building owners of the potential energy savings by using energy efficient construction. Building owners should be made aware of the importance of properly insulating their building as it is being built. It should be impressed upon potential builders that for small incremental costs the potential savings can be quite high. It should also be made clear to potential builders that retrofit costs are much greater than the costs of implementing energy efficient construction as the building is being built.

TABLE 4

ENERGY EFFICIENT CONSTRUCTION

PROPONENT	PROJECT COST	PAYBACK PERIOD	APPLICATION
D. Sudom	$ 6,360	32.0 years	Sunspace
J. Tucker	$10,500	50.0 years	Sunspace
P. Shoemaker	$ 3,355	9.6 years	Energy Efficient Home
Humber Gardens	$ 4,155	5.7 years	Refrigerant Insulation
Boy Scouts - Girl Guides	$ 3,604	3.5 years*	Trombe Wall

* Original prediction.

5.2 Heat Recovery

5.2.1 Description

Many commercial establishments produce and expel large quantities of excess heat. Refrigerators or freezers in stores transfer heat from food to condenser coils where it is often released to the air. Oil fired generating stations expel large quantities of heat during their operation. Often, the ventilation systems in buildings simply expel this warmed air directly outdoors. By recovering this wasted heat, space heating costs can be greatly reduced in these buildings or sent to other connected nearby buildings through district heating systems. Pumping the heat back into the buildings for space heating, via heat exchangers and recovery units, or using the waste heat from generating sites to heat nearby buildings, can provide an efficient low cost way to provide heat.

There were four types of heat recovery technologies with seven projects funded under the Small Scale Energy Demonstration Program. Each of these technologies, in some manner, recovered heat from either waste water or air which was to be expelled from the building. These four technologies were 1) 4-refrigerant heat recovery, 2) water reuse, 3) heat exchangers, and 4) a heat pump.

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Refrigerant Heat Recovery
The Aquarena

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Aquarena

Project Manager:
Canada Games Park
Commission

Date:
August, 1985

Project Number:
03:04:22:34

Status:

Technology:
Conservation
(Heat Recovery)

Sector:
Recreational
(Swimming Pool)

Province:
Newfoundland

Purpose:

To demonstrate the use of waste heat from water-cooled condensing units, to preheat domestic hot water for an aquatic sports complex.

Description:

Waste heat from the air-conditioning system was already used to heat pool water. A system was installed which diverted the condensor cooling water to a heat exchanger in the domestic hot water supply, when pool heating was not required.

Contributors:

Canada Games Park Comm.	$10,050
Canada/Newfoundland	$10,500
Total	$20,550

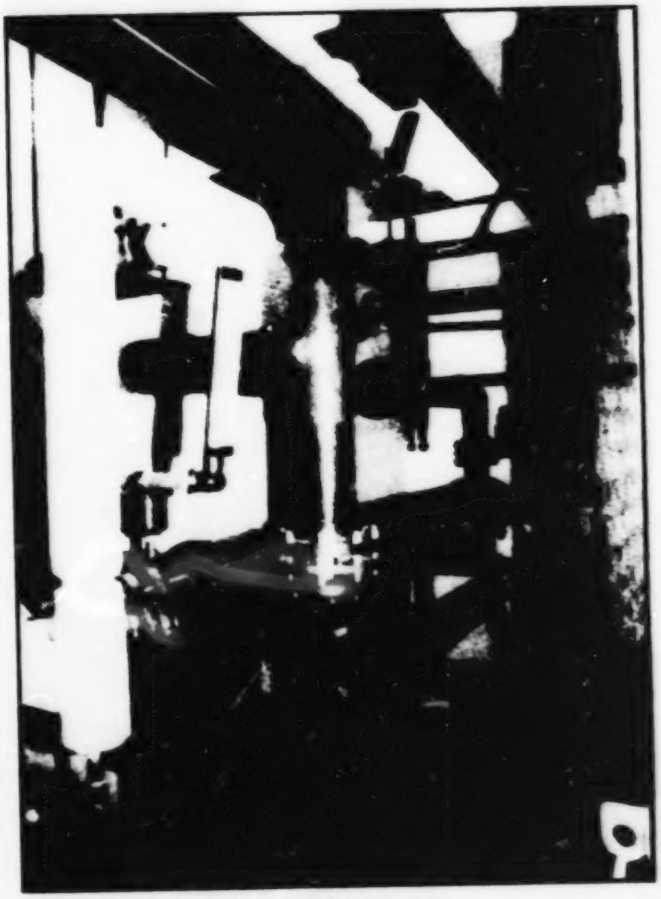
Demonstrated Benefits/Savings:

The system provides a net annual savings of $5,700 or 19% of the domestic hot water energy consumption.

Information Contact:

Canada Games Park Comm. or
17 Westerland Road
St. John's, Nfld.
A1B 3R7
Phone: (709) 754-1977

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
Phone: (709) 576-2411



The heat exchanger for domestic hot water.

SMALL SCALE PROJECT

REFRIGERANT HEAT RECOVERY

Project Costs

Capital	$16,000
Installation & Services	$ 4,050
Total	$20,050
Monitoring & Technology Transfer	500
Total Demonstration Cost	$20,550

Operating Costs

Pre-Installation	$30,000
Post-Installation	24,300
Net Savings	$ 5,700
Simple Payback Period	3.5 years

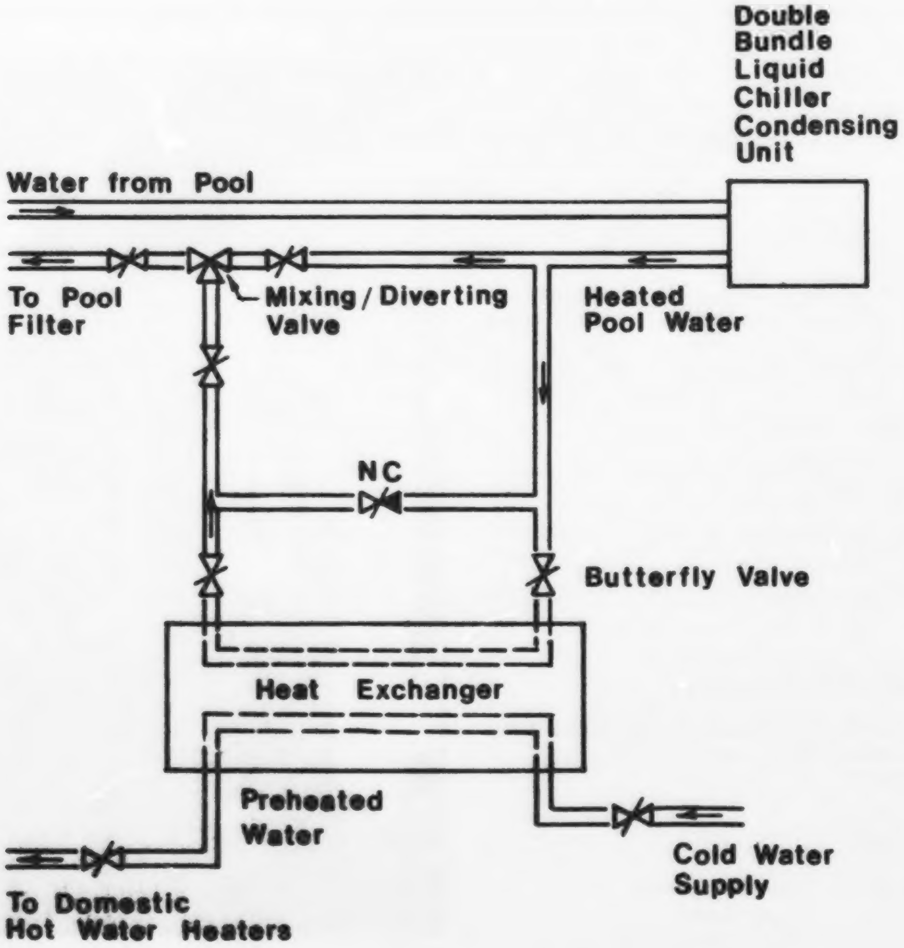
Monitoring/Evaluation:

Records of intake and output temperatures, and water consumption, were taken on a daily basis.

Technical Details/Specifications:

The system uses 21.5 L/s of condensor cooling water at 33° to heat 3.16 L/s of the hot water supply from 4.5° to 25.3°. The heat exchanger is an ITT-Bell and Gossett U-tube unit, model #1210-49, with a capacity of 275 kW.

Schematic Diagram of Refrigerant Heat Recovery


Double Bundle Liquid Chiller Condensing Unit
Water from Pool
To Pool Filter
Mixing / Diverting Valve
Heated Pool Water
NC
Butterfly Valve
Heat Exchanger
Preheated Water
Cold Water Supply
To Domestic Hot Water Heaters

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Heat Recovery and Power Factor Correction
Hodder Memorial Stadium

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Deer Lake

Project Manager:
F. Wells
Plant Manager

Date:
August, 1985

Project Number:
03:04:22(2):38
Status:
Complete

Technology:
Conservation
(Heat Recovery)

Sector:
Recreational (Arenas)
Province:
Newfoundland

Purpose:

To demonstrate the energy savings possible in a 2,500m^2 ice arena, through the recovery of refrigerant compressor heat and power factor correction for motors.

Description:

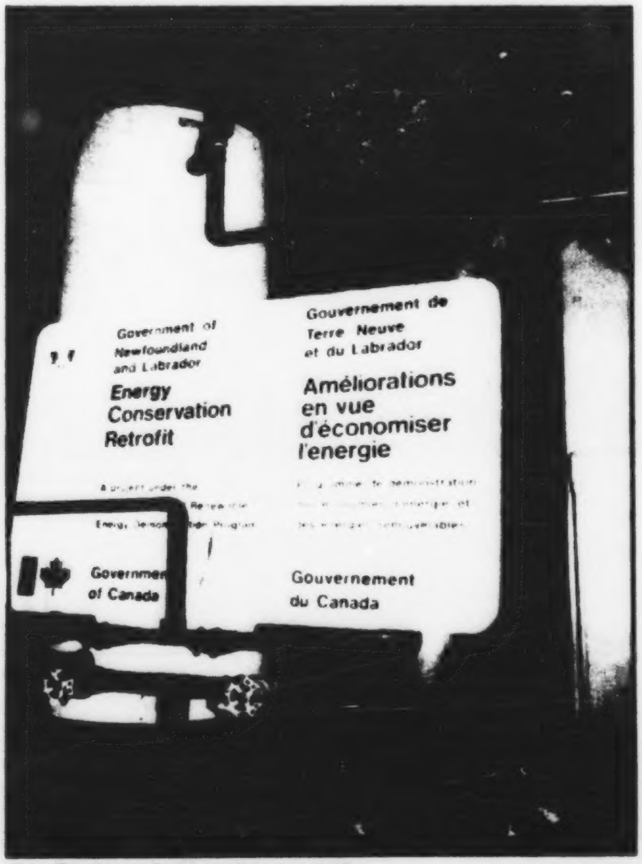
Hot refrigerant gas is directed through desuperheat-plate jackets around large-capacity water heaters. The power factors of refrigeration system motors were improved by installing capacitors on them.

Contributors:

Town of Deer Lake	$ 5,049
Canada/Newfoundland	$10,901
Total	$15,950

Demonstrated Benefits/Savings:

The installation of these energy saving systems had reduced annual energy bills by $2,800 (7.8%)


Government of Newfoundland and Labrador
Energy Conservation Retrofit
Gouvernement de Terre Neuve et du Labrador
Améliorations en vue d'économiser l'energie
Government of Canada
Gouvernement du Canada

The Egosaver heat exchanger tanks.

Information Contact:

F. Wells
Plant Manager
Town of Deer Lake
Box 940
Deer Lake, Nfld.
A0K 2E0
Phone (709) 635-2451

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone (709) 576-2411

SMALL SCALE PROJECT

HEAT RECOVERY AND POWER FACTOR CORRECTION

Economic Analysis:

Project Costs

Labour	$ 9,350
Capital Cost	$ 5,500
Total Installed Cost	$14,850
Monitoring & Technology Transfer	$ 1,100
Total Demonstration Cost	$15,950

Operating Costs

Pre-Installation	$36,000
Post-Installation	$33,200
Net Savings	$ 2,800
Simple Payback Period	5.3 years

Monitoring/Evaluation

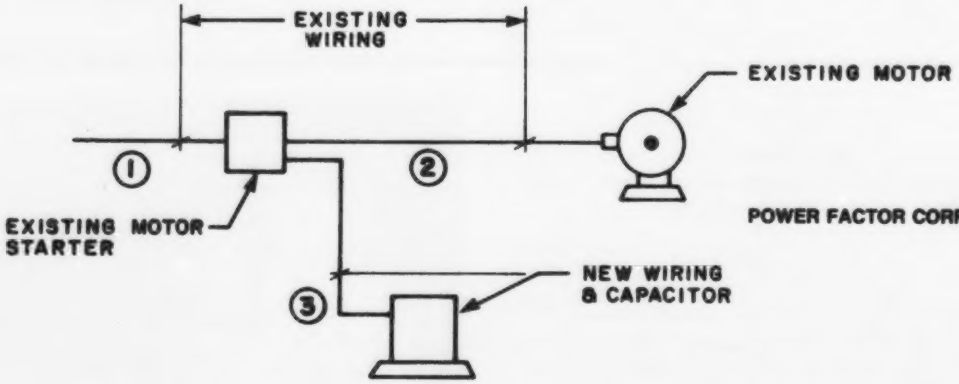
Items which are being monitored include:

(1) Egosaver output by BTU meter

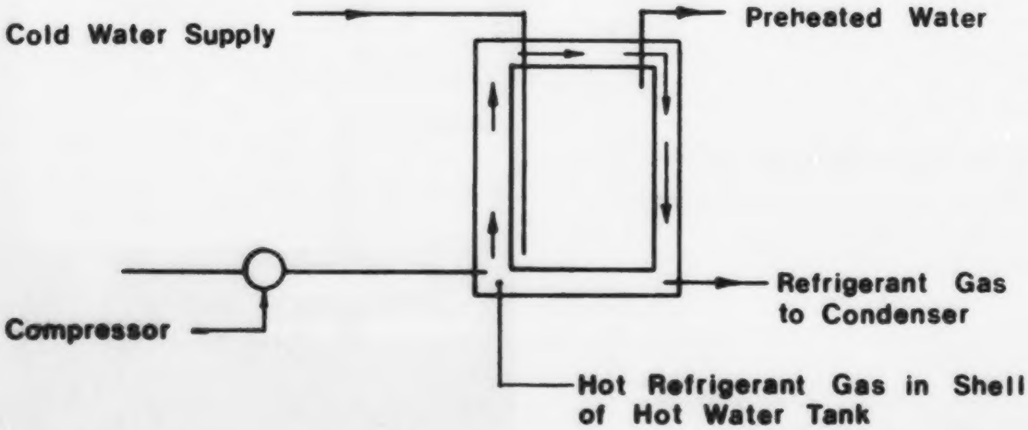
(2) Power factor correction by comparing utility bills kVA and kWh before and after installation of capacitors for one calendar year. The savings are based on three months' data.

Technical Details/Specifications:

An EA40 Egosaver heat exchanger was installed which removes heat from the hot gas in the refrigerant unit. This heat is used to preheat the cold water supply to two 450L domestic hot water tanks. Two 600V, 10 kVAR and one 600V, 5kVAR capacitors were installed on the compressors and brine pump motors to improve the power factors and thus lower the demand charges.


EXISTING WIRING
EXISTING MOTOR
①
②
EXISTING MOTOR STARTER
NEW WIRING & CAPACITOR
③

POWER FACTOR CORRECTION CAPACITOR


Cold Water Supply
Preheated Water
Compressor
Refrigerant Gas to Condenser
Hot Refrigerant Gas in Shell of Hot Water Tank

HOT GAS HEAT RECOVERY SYSTEM

Energy, Mines and
Resources Canada

Energie, Mines et
Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Refrigerant Heat Recovery
Humber Gardens

CREDA
Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Corner Brook

Project Manager:
J. Warford, P.Eng.

Date:
August, 1985

Project Number:
03:04:22(2):03
Status:
Complete

Technology:
Conservation (Heat Recovery)

Sector:
Recreational (Arenas)
Province:
Newfoundland

Purpose:

To demonstrate energy conservation by recovering heat from hot refrigeration gas in a skating arena.

Description:

Hot refrigeration gas preheats cold water storage tanks. The tanks are specially designed combination heat exchangers and storage tanks with a combined capacity of 900 litres.

Contributors:

City of Corner Brook	$ 6,338
Canada/Newfoundland	$10,000
Total	$16,338

The Humber Gardens complex.

Demonstrated Benefits/Savings:

The arena reduced the hot water energy bill by 82 per cent, saving $1,740 annually.

Information Contact:

J. Warford, P. Eng.
City of Corner Brook
P. O. Box 1080
Corner Brook, Nfld.
A2H 6E1
Phone (709) 634-8291

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
(709) 576-2411

SMALL SCALE PROJECT

REFRIGERANT HEAT RECOVERY

Economic Analysis:

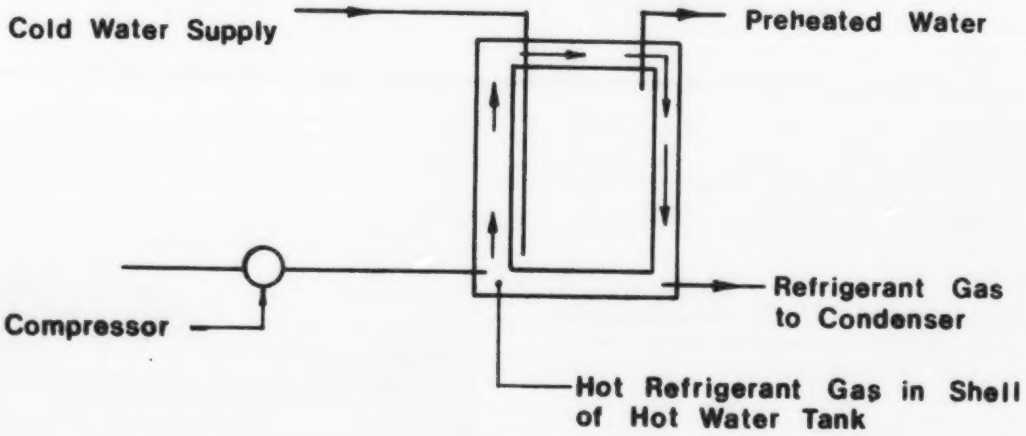
Project Costs	
Capital	$10,000
Installation	$ 5,208
Total Installed Cost	$15,208
Monitoring & Technology Transfer	$ 1,130
Total Demonstration Cost	$16,338
Operating Costs	
Pre-Installation	$ 2,120
Post-Demonstration	$ 380
Net Savings	$ 1,740
Simple Payback Period	8.7 years

Monitoring/Evaluation:

An energy meter was installed to monitor water flow, temperature rise, and energy supply to the water tanks.

Technical Details/Specifications:

The two 450 L store tanks have a desuperheat jacket, which allows hot refrigerant gases to preheat water for the main hot water tank.


Cold Water Supply
Preheated Water
Compressor
Refrigerant Gas to Condenser
Hot Refrigerant Gas in Shell of Hot Water Tank

HOT GAS HEAT RECOVERY SYSTEM

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Government of Newfoundland & Labrador

Waste Heat Recovery
City Consumers Co-Op Food Store

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Mount Pearl

Project Manager:
City Consumers Co-op

Date:
February, 1985

Project Number:
03:04:22:06

Status:
Complete

Technology:
Waste Heat Recovery

Sector:
Retail (Food)

Province:
Newfoundland & Labrador

Purpose:

To demonstrate energy conservation in a 1765 m² new food store by energy-conserving air conditioning and refrigeration systems and by utilizing waste refrigeration heat for space heating.

Description:

The heating, ventilating, air conditioning and refrigeration design consists of:
1) Air conditioning and store
2) Using a condenser to dehumidify building air, and reheating it before recirculating.
3) Combining selected coolers to a common refrigeration system with hot gas defrost and
4) using refrigeration waste heat to assist in building heating.

Contributors:

City Consumers Co-op	$13,500
Canada/Newfoundland	$ 9,900
Total	$23,400

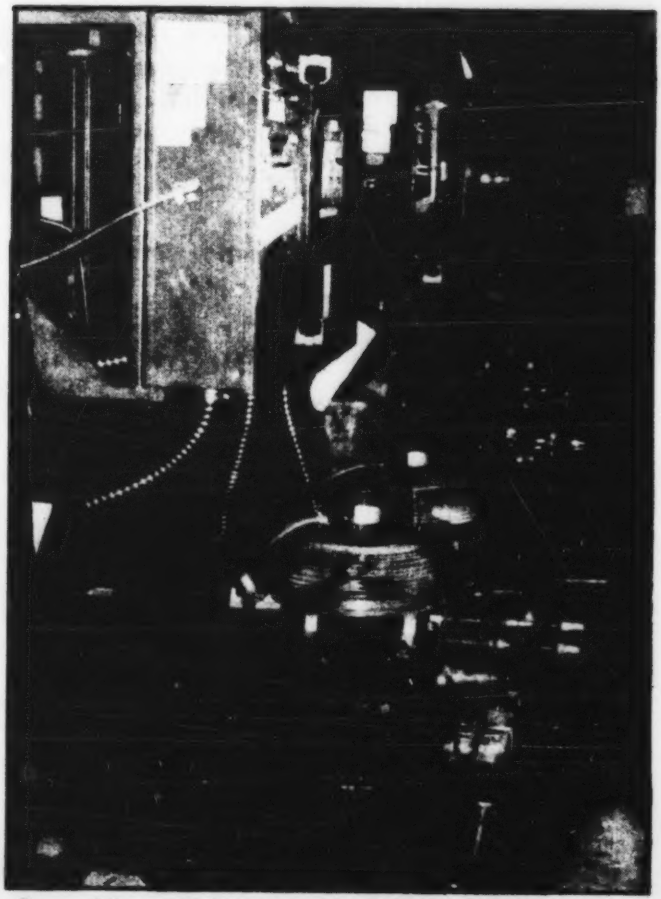
Demonstrated Benefits/Savings:

Savings of $8,180 per year, i.e. one-third of the annual energy bill, plus a more comfortable and controllable environment have been achieved.

Information Contact:

City Consumers Co-Op Limited or
P. O. Box 160
Mount Pearl, Newfoundland
A1N 2C2
Phone: (709) 368-3181

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 576-2411



Some of the waste heat recovery equipment installed.

SMALL SCALE PROJECT

Economic Analysis:

Project Costs

Materials & Installation	$22,900
Total Installed Cost	$22,900
Monitoring & Technology Transfer	$ 500
Total Demonstration Cost	$23,400

Operating Costs

Energy Costs Based on Old Store Design	$24,865
Energy Costs of New Design	$16,685
Net Energy Savings	$ 8,180
Simple Payback Period	2.8 yrs.

The design costs are based on projections from other similar stores.

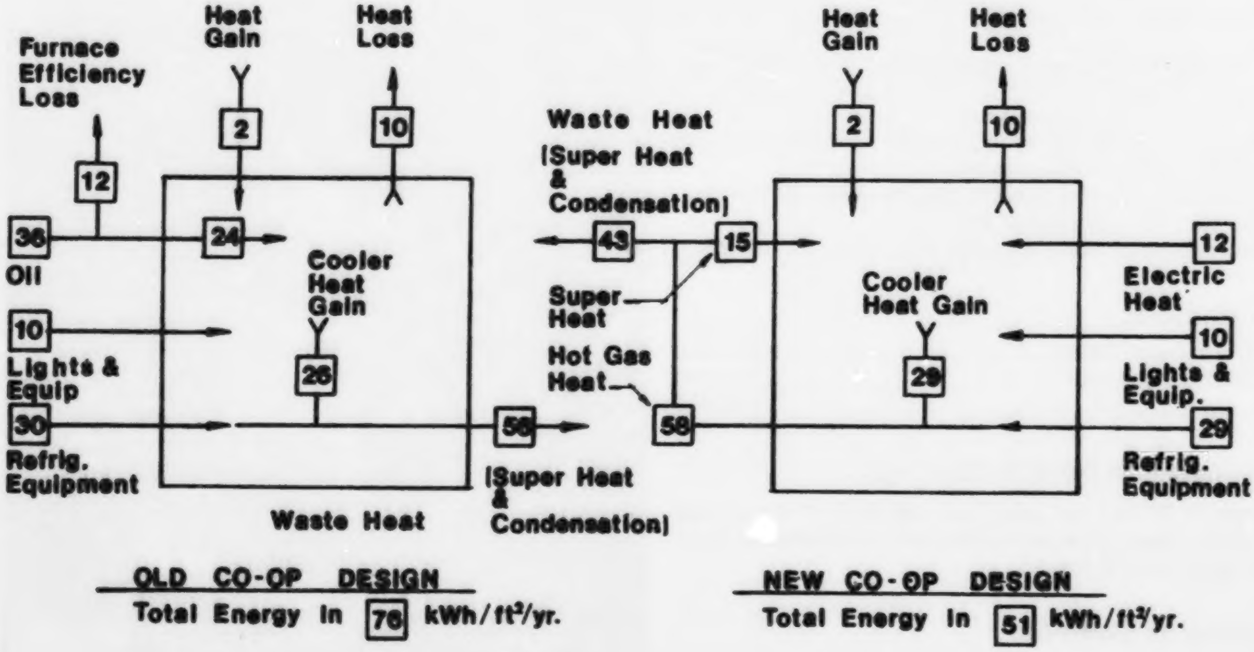
Monitoring Evaluation:

For a two year period the proponent recorded (1) the energy consumed by each of the devices (2) total energy consumed for heating (3) humidity levels (4) indoor and outdoor temperatures and (5) downtime and other problems.

Technical Details/Specifications:

The new City Consumers Co-op store has incorporated several Hussmann and Blanchard Ness machines to reuse heat and save energy. The heat removed by the refrigerating units, (ordinarily dumped outdoors), is recirculated back into the store for space heating. Return air ducts are placed near the refrigerating units to provide better comfort levels by eliminating "cold aisles" near cooler sections. Humidity is properly controlled to reduce compressor loads and protect other foods. Finally, the compressors have been placed on a common header to help improve efficiency. The maximum output of all the heating and heat reusing equipment is 145 KW.

Schematic Diagram of Typical Energy Usage Values (kWh/ft²/yr.) in stores of old and new design.


Furnace Efficiency Loss
12
Heat Gain
2
Heat Loss
10
36
Oil
24
Cooler Heat Gain
26
10
Lights & Equip
30
Refrig. Equipment
56
Waste Heat
(Super Heat & Condensation)
Waste Heat
(Super Heat & Condensation)
43
15
Super Heat
Hot Gas Heat
58
Heat Gain
2
Heat Loss
10
Cooler Heat Gain
29
12
Electric Heat
10
Lights & Equip.
29
Refrig. Equipment
OLD CO-OP DESIGN
Total Energy In 76 kWh/ft²/yr.
NEW CO-OP DESIGN
Total Energy In 51 kWh/ft²/yr.

Note: 1 kWh/ft²/yr. = 10.76 kWh/m²/yr.

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Mines & Energy
Newfoundland

Water Re-Use in Fish Culture
Marine Science Research Laboratory

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Marine Science Research Laboratory
Marine Drive, St. John's
Newfoundland

Project Manager:
Dr. A. Sutterlin
Marine Science Research Laboratory
Memorial University of Newfoundland

Date:
May, 1983

Project Number:
03:04:22:23

Status:
Completed

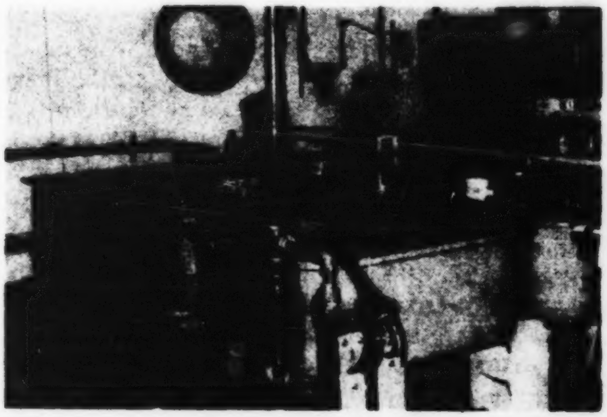
Technology:
Energy Efficient Heat Recovery

Sector:
Institutional

Province:
Newfoundland

Purpose:

To demonstrate energy conservation in fish culture by re-using water through an ozonization purification process.



Description:

Warm fish hatchery water is recirculated while preventing the build-up of toxic metabolic products. Previously, water went through a single pass system, which meant it was heated, used and then discharged. That system eliminated the build-up of toxic wastes but resulted in high energy costs.

Contributors:

Canada	(CREDA)	$6,212.00
Newfoundland	(CREDA)	1,553.00
Memorial University of Newfoundland		4,765.00
	Total	$12,530.00

Demonstrated Benefits/Savings:

Actual 95% reduction in energy consumption from the single pass system, resulting in annual cost savings of $6,900.00 and energy savings of 19,000 L of oil annually. This is in line with anticipated savings. The survival rate of fish has actually increased with the new system.

Further Information:

A final report is available, and a poster will also be produced.

Information Contact:

Dr. A. Sutterlin
Marine Science Research Laboratory (MSRL)
Marine Drive
St. John's, Newfoundland
Phone: (709) 726-6687

or Clarissa Dicks, Information Coordinator
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 737-2411

SMALL SCALE PROJECT

Project Name:

Water Re-Use in Fish Culture

Economic Analysis:

Project Costs:

Capital	$4,605.00
Installation	400.00
Total installed cost	$5,005.00
Repairs, maintenance, monitoring for one year (MSRL)	4,525.00
Technology transfer and demonstration (CREDA)	3,000.00
Total demonstration cost	$12,530.00

Operating Costs:

Pre-demonstration annual fuel cost	$7,518.00
Post-demonstration annual fuel cost	$618.00
Net annual fuel savings	$6,900.00
Simple Payback Period: 9 months	9 months

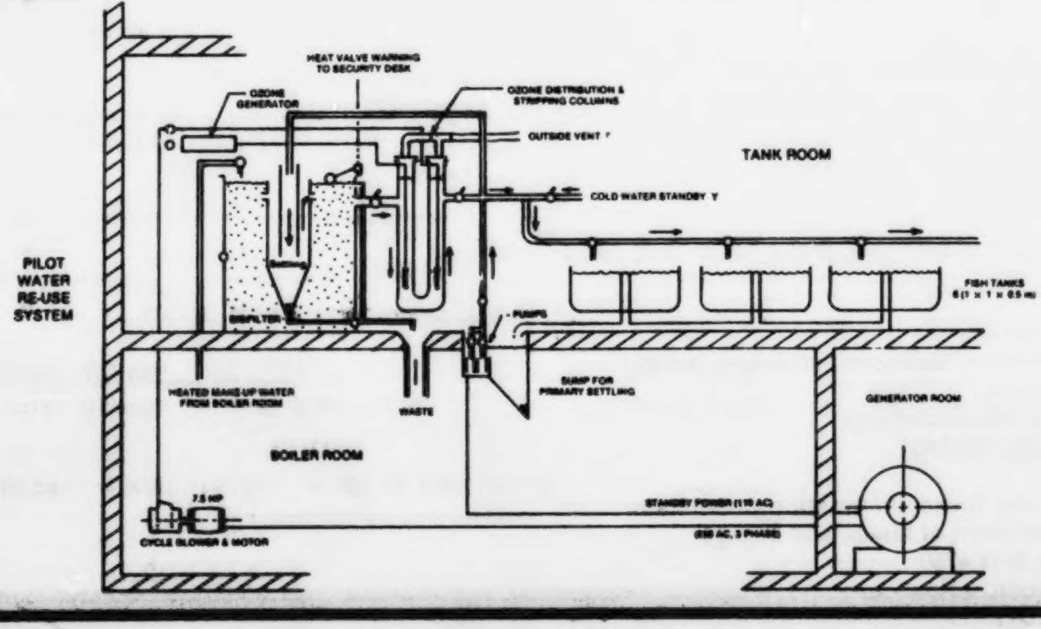
Monitoring/Evaluation:

The laboratory monitored temperature; levels of pH, DO, NH_3, $-NH_4^+$, nitrite and nitrate, humic acid and particulate organic carbon; water clarity; growth rate; mortality rate; energy consumption; energy savings.

Technical Details/Specifications:

Water re-use in fish culture depends primarily on preventing the build-up of toxic metabolic products released by fish. This is accomplished by interposing a biological filter consisting of submerged substrate upon which nitrifying bacteria become established. The ammonia released by the fish is metabolized by various types of bacteria to nitrite and finally to nitrate. Correct functioning of a biological filter depends on good aeration and the removal of the particulate organic load through primary and secondary settling. The system is filled with water sterilized with U.V. light and bacterial nutrients consisting of phosphate, ammonia and a carbon source. Bacterial and fungal levels in water returning to the culture tanks are controlled by ozone acting as an oxidizing and sterilization agent.

Schematic Diagram:


HEAT VALVE WARNING TO SECURITY DESK
OZONE GENERATOR
OZONE DISTRIBUTION & STRIPPING COLUMNS
OUTSIDE VENT
TANK ROOM
COLD WATER STANDBY
PILOT WATER RE-USE SYSTEM
FISH TANKS 6 (1 × 1 × 0.5 m)
BIOFILTER
PUMPS
HEATED MAKE-UP WATER FROM BOILER ROOM
WASTE
SUMP FOR PRIMARY SETTLING
GENERATOR ROOM
BOILER ROOM
7.5 HP
CYCLE BLOWER & MOTOR
STANDBY POWER (110 AC)
(208 AC, 3 PHASE)

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Laundromat Waste Heat Recovery
Merrymeeting Laundromat

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Merrymeeting Laundromat

Project Manager:
Genoa Engineering

Date:
August, 1985

Project Number:
03:04:22(2):52

Status:
Complete

Technology:
Conservation (heat recovery)

Sector:
Commercial

Province:
Newfoundland

Purpose:

To demonstrate a system which recovers waste heat in laundromats, for preheating the cold water supply.

Description:

Hot and warm water from the washing machines is piped to a heat exchanger, where heat is transferred to the main boiler feed water. Cold water from washing and rinsing is diverted into the drainage system.

Contributors:

Chester E. Dawe	$ 4,255
Canada/Newfoundland	$11,200
Total	$15,455

Demonstrated Benefits/Savings:

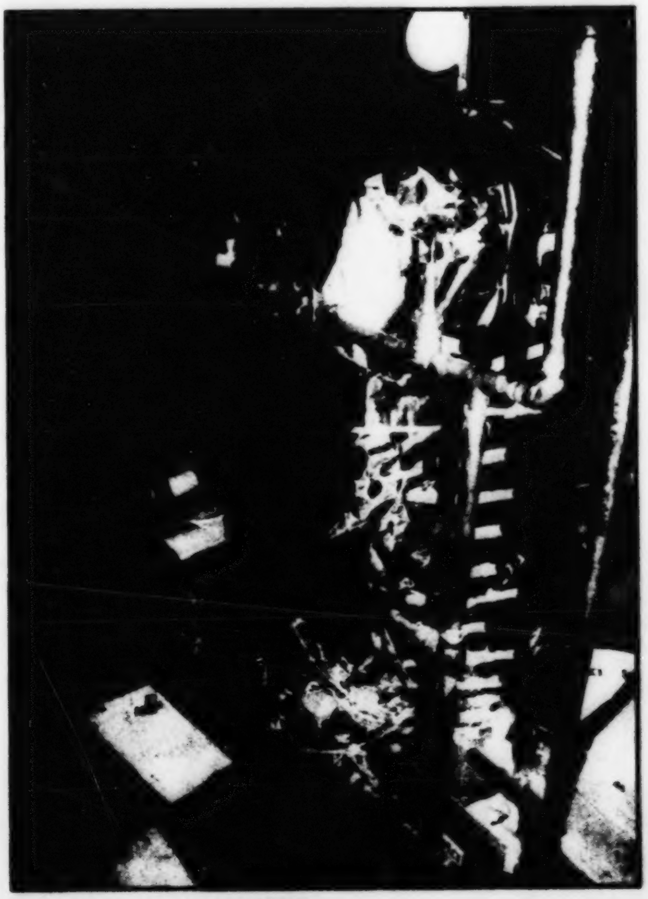
The project saved $3,000 or 14% of the annual energy bill of $28,000.

Information Contact:

Genoa Engineering
118 Springdale Street
St. John's, Nfld.
A1C 5B6
Phone: (709) 722-2394

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411



The heat exchanger installation.

SMALL SCALE PROJECT

LAUNDROMAT WASTE HEAT RECOVERY

Economic Analysis:

Project Costs

Capital	$ 4,378
Installation	$ 7,437
Total Installed	$11,815
Monitoring & Technology Transfer	$ 3,640
Total Demonstration	$15,455

Operating Costs

Pre-Installation	$28,000
Post-Installation	$24,100
Net Savings (14% of $28,000)	$ 3,900
Simple Payback	3 years

Monitoring/Evaluation:

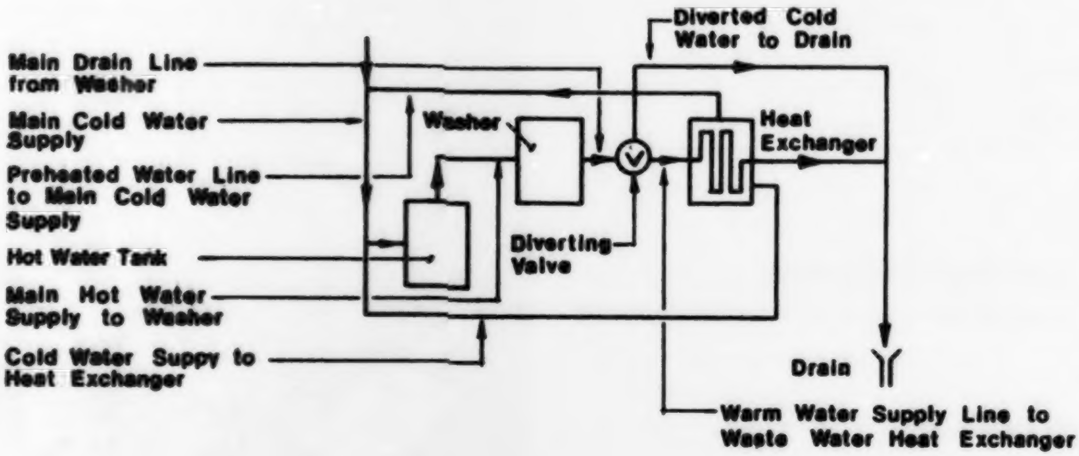
Items monitored 7 days before and 7 days after installation included:

(1) Number of hot, cold and warm washes; (2) quantity of oil; (3) temperature records; room, hot water and cold water; (4) waste water temperature and; (5) boiler firebox efficiency.

Technical Details/Specifications:

The heat exchange unit installed at Merrymeeting Laundromat is a shell and coil type capable of transferring 13.7 kW of energy. The diverter valve is a Maytag design, installed to divert water through the heat exchanger. Its operation is triggered by a bimetallic strip thermostat mounted on the washing machine drum and set to switch at 27°C. The initial design did not meet expectations because waste water was not always moving in the heat exchanger, and as a result the copper tubes became fouled. The problem was resolved with a second shell and tube heat exchanger.

Schematic Diagram of Laundromat Waste Heat Recovery


Diverted Cold Water to Drain
Main Drain Line from Washer
Main Cold Water Supply
Washer
Heat Exchanger
Preheated Water Line to Main Cold Water Supply
Hot Water Tank
Diverting Valve
Main Hot Water Supply to Washer
Cold Water Suppy to Heat Exchanger
Drain
Warm Water Supply Line to Waste Water Heat Exchanger

Heat Pump Lumber Dryer

Russworthy Woodworking Limited

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Torbay

Project Manager:
D. Doull

Date:
August, 1985

Project Number:
04:22(2):53

Status:
Complete

Technology:
Waste Heat Recovery

Sector:
Commercial

Province:
Newfoundland

Purpose:

To demonstrate the use of a heat pump dehumidifier/heater for conditioning air in a wood drying operation.

Description:

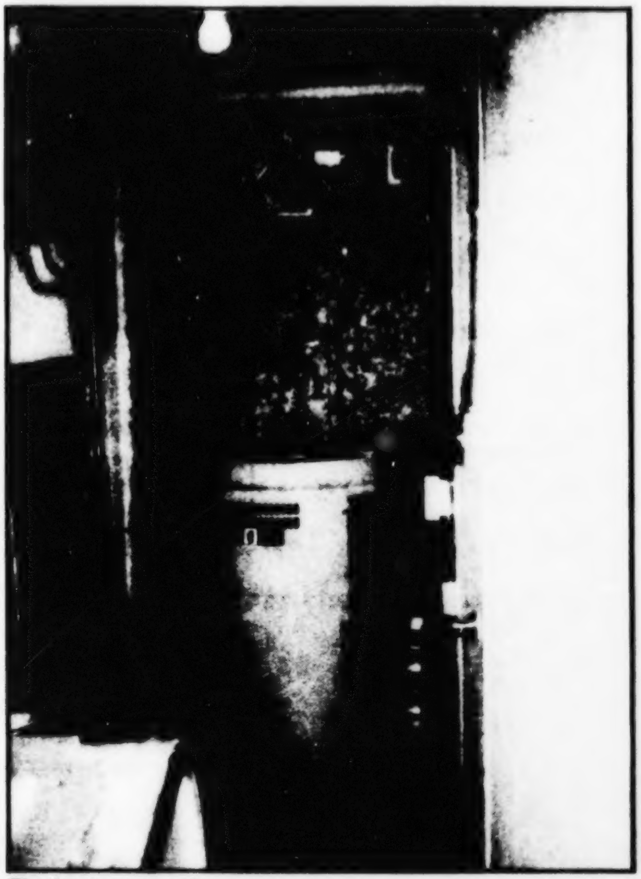
For wood drying, warm, dry air is required. An air cooling/reheating heat pump system was installed in the drying room to recondition circulated air, instead of a through-ventilation system with simple heating. Excess heat is used for space heating.

Contributors:

Russworthy Woodworking Ltd	$16,500
Canada/Newfoundland	4,226
Total	$20,726

Demonstrated Benefits/Savings:

The unit does adequately dry the wood without having to heat the air to higher temperatures.


The heat pump unit.

Information Contact:

W. Hutchings
P. O. Box 340
Torbay, Newfoundland
A0A 3Z0
Phone: (709) 437-6982

or

Information Section
Energy Branch
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone (709) 576-2411

SMALL SCALE PROJECT

HEAT PUMP LUMBER DRYER

Economic Analysis:

Project Costs

Capital	$12,000
Installation	8,000
Total Installed	$20,000
Monitoring and Technology Transfer	726
Total Demonstration Cost	$20,726

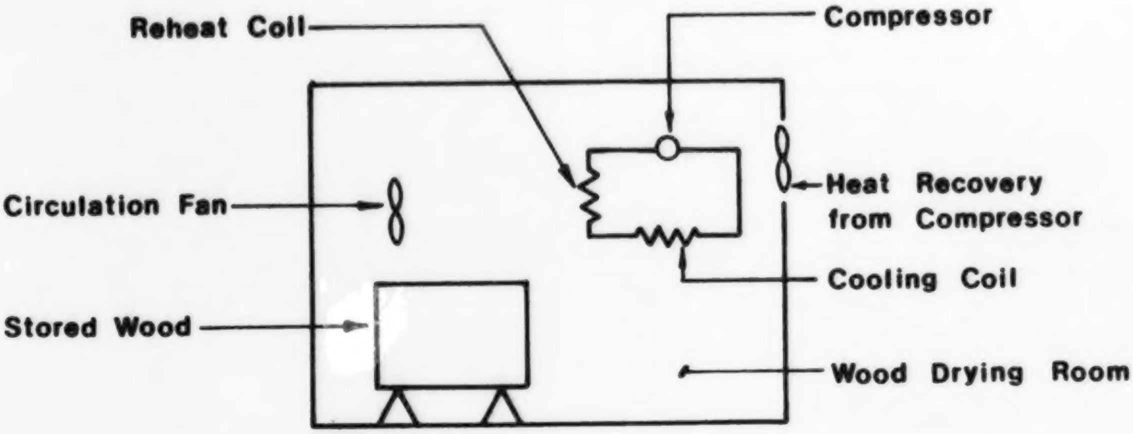
Monitoring/Evaluation:

Due to the closing of the Russworthy operation, the system is presently in another location. The proponent is keeping a record of its use, however previous fuel bills are unavailable, and the unit's output is not being monitored.

Technical Details/Specifications:

The drying chamber is a well insulated, airtight room, with a capacity of 4,000 board feet. The heat recovery system consists of Carrier equipment (cooling and fan/reheat coil units, and a condenser). A 5kW electric heater, which supplies hot air for resin curing, is used for initial heating of the dryer air after loading. A full chamber of birch can be dried from 25% moisture content to 6% in 21 days, removing 360 litres of water. Green birch (45% moisture content) was also dried successfully.

Heat Pump Lumber Dryer


Reheat Coil
Compressor
Circulation Fan
Heat Recovery from Compressor
Cooling Coil
Stored Wood
Wood Drying Room

5.2.2 Project Applications

Table 5 (Page 50) shows a list of the project proponents, project costs, payback periods, and applications. It is interesting to note that all seven heat recovery projects are owned by commercial proponents. The possible explanations for this observation are mentioned in the final conclusion of this report.

The cost of these projects ranged from $12,530 to $23,400. The payback periods of these projects were good ranging from 9 months to 9.4 years.

Unfortunately monitoring information for Russworthy Woodworking is not available. The project equipment was moved location due to unexpected problems at Russworthy Woodworking. The heat recovery unit is operating but no monitoring is taking place.

5.2.3 Observations

Each of these projects used a heat recovery device to recover heat which normally would have been wasted. The heat recovery project at City Consumers Co-op also included environmental controls and efficient operation methods. However, the bulk of the project cost was in heat recovery.

5.2.3.1 Refrigerant Heat Recovery

There were four projects which recovered heat from hot refrigerant gases or condensers. The City Consumers Co-op had to cool the food display cases while the Humber Gardens and the Hodder Memorial Stadium had to freeze their ice rink for skating. The Aquarena had to dehumidify the moist air to prevent structural damage.

In each case compressors extract heat from a heating containing source and transfer it, via a refrigerant, to a condenser. The heat is removed from the refrigerant and transferred to a heat sink. Often this heat sink is outside air so that heat is simply being removed to the outdoors. By recovering this heat and reusing it to preheat air or water, significant reductions in heating costs are possible, since the recovered heat is used to offset primary heating sources.

Hodder Memorial Stadium and Humber Gardens both use a heat exchanger to recover heat directly from hot refrigerant gasses. This recovered heat is then used to preheat the water supply to the domestic hot water.

The built-up heat pump system at the Aquarena is used to dehumidify the building and return the rejected heat to the pool water. During certain times of the year additional heat is rejected to outdoor condensers when the pool temperature is satisfied. The addition of a water-to-water heat exchanger allows this heat to be redirected to be recovered in the domestic hot water system. If the pool water temperature is above a certain point, the pool water flow from the condenser is diverted to the heat exchanger. The heat transfered in this heat exchanger is used to preheat the water supply to the domestic hot water.

The Co-op heat recovery system is fairly complicated. As well as a condenser heat recovery system there were environmental controls, humidity controls, and efficient compressor operating systems, all installed under this project. The compressors are mounted on a common header to improve efficiency. The humidity is kept low to reduce compressor loads and to maintain dried food quality. The heating, air conditioning and ventilating systems are all designed to run with greater efficiency by controlling the hours of operations and environmental conditions. Finally heat is recovered from the condensing units and is put back into the building for space heating needs.

All of these systems are working very well and are providing excellent payback periods. There is usually no need to discharge heat from refrigerant systems while money is being spent on space heat or domestic hot water. There are many grocery stores with refrigerators and freezers, stadiums with ice making facilities, and other building where condensers release heat to the atmosphere. This is a total waste of heat energy which can be efficiently recovered.

5.2.3.1 Refrigerant Heat Recovery (Cont'd)

Future government energy projects will certainly find requests for funding from commercial proponents with these refrigerant systems. These future projects are sure to be successful if they are completed in a similar manner to these four heat recovery projects.

5.2.3.2 Water Reuse

The Marine Sciences Research Laboratory, (MSRL), warm fish hatchery is using a biological filter to allow for the reuse of warm water. Originally, water was heated, used once in the tank, and then discharged. Now, water is passed through a biological filter where nitrifying bacteria metabolize the ammonia released by the fish. Primary and secondary settling helps to remove suspended organic matter.

The system saves the MSRL $6,900 annually, on hot water heating bills, giving the project a payback period of 9 months. The system appears to be operating very well and could be used to demonstrate to other similar facilities how well such a system can work.

5.2.3.3 Heat Exchanger

Merrymeeting Laundromat has installed a heat recovery system to capture heat from the waste water from their washing machines. A diverter valve on each washing machine diverts water above 27°C to a heat exchanger. Water below 27°C is dumped to a drain. The heat transfered from the heat exchanger preheats the supply water to the domestic hot water heaters.

5.2.3.3 Heat Exchanger (Cont'd)

The original design of this system did not work because water was not always moving in the heat exchanger and as a result the copper tubes in the heat exchanger became fouled. Now a second heat exchanger which acts as a storage tank has been installed and the system is operating well. This project is saving Merrymeeting Laundromat $3,000 annually and is providing a payback period of 4.2 years. With the modification in design this system is now operating as it should. In many cases, waste water from laundromats is simply being dumped to a drain. With a 4.2 year payback period, any future government projects in waste water heat recovery technology should certainly receive serious consideration for funding requests.

5.2.3.4 Heat Pump

Russworthy Woodworking in Torbay had installed a refrigerant dehumidifier dryer to preheat the kiln air system to dry various quantities of wood. In this kiln warm air was circulated around the wet lumber, thereby absorbing moisture contained in the wood. The warm moist air was fed through a heat pump system where it was dehumidified, reheated, and returned to the kiln. Excess heat from the process was to be diverted into the store to offset space heating requirements. The application of this technology is innovative and shows great promise for replication in the future.

5.2.3.4 Heat Pump (Cont'd)

Unfortunately, Russworthy Woodworking has gone out of business and as a result the heat pump's drying system is no longer in operation at the original location. It is now installed in a garage of one of the previous owners of Russworthy Woodworking. The system is operating, however, no monitoring of the system is taking place and hence there is absolutely no monitoring data available to evaluate the success of this project.

5.2.4 Cost/Benefit Analysis

Monitoring results of these projects shows a very significant energy savings in each case. In most cases, payback periods were less than 6 years which indicates a very high degree of success. Future waste heat recovery projects, if designed and operated properly, are sure to realize the same high degree of success as have these projects. From a financial point of view it is unwise to simply dump heat into the atmosphere. Even on a small scale it would still be feasible to make use of heat recovery systems.

5.2.5 Conclusions

None of heat recovery projects used an outstanding new technology to recovery heat. The technology has been around for some time and as a result devices and systems available are very efficient.

5.2.5 Conclusions (Cont'd)

Any future government energy demonstration programs will most certainly have requests for funding in the heat recovery sector. The costs of these projects are often very high and the proponents often need financial assistance to get the projects started. The success of these projects will certainly make similar future projects very popular.

5.2.6 Recommendations

Except for Russworthy Woodworking, all of the proponents projects are operating well. The heat pump and kiln system owned by Russworthy Woodworking is operating at a different location and, its performance is unmonitored. To avoid such a situation in the future, the proponent should be required to refund the government money or ensure the required monitoring data is provided. Since the system is operating, monitoring data should be made available.

Because of the great success of the rest of these projects, any future government projects in this sector will almost certainly attract a large number of applicants. A number of the heat recovery projects funded were located in places where tax payers or communities must pay for the operation of those facilities. Government investment in these facilities can be a very wise decision when the payback periods reflect a substantial savings.

TABLE 5

HEAT RECOVERY

PROPONENT	PROJECT COST	PAYBACK PERIOD	APPLICATION
Aquarena	$20,050	3.5 years	Condensor Heat Recovery
Hodder Memorial Stadium	$15,950	*5.3 years	Heat Exchangers
Humber Gardens	$15,208	8.7 years	Heat Exchangers
City Consumers Co-op	$22,900	2.8 years	Heat Recovery
Marine Sciences Research Lab (MSRL)	** $ 9,530	1.4 years	Water Reuse
Merrymeeting Laundromat	$11,815	3.0 years	Heat Exchanger
Russworthy Woodworking	$20,000	N/A	Heat Pump

* Included Power Factor Correction
** Repairs Included
N/A Not Applicable

5.3 Energy Management & Control

5.3.1 Description

Improper regulation and control of energy consumption and environmental systems can lead to a tremendous amount of wasted energy. This is especially true for larger buildings where monthly energy consumption can reach over $10,000. However, on a smaller scale, proper energy management can be of equal importance to home owners and smaller businesses.

Power factor improvements, humidity controls, and night setback thermostats can reduce energy consumption by a very considerable amount. Because the savings can be so high for this type of technology, payback periods can be exceptionally low making it a very attractive investment.

There were five types of energy management and control technologies demonstrated with six projects funded under the Small Scale Energy Demonstration Program. These projects were: (1) night setback thermostat, (2) pool blanket, (3) 2-power factor corrections, (4) environmental control, and (5) instantaneous hot water heaters.

5.3.2 Project Applications

All of these 6 projects have now been completed. Table 6 (Page 60) shows a list of the proponents, project costs, payback periods and applications. The capital costs of these projects range from $1,062 to $40,012. The payback periods range from 2.5 years to 9 years.

All of the projects are now complete and monitoring data has been supplied for all except two of the projects. Newfoundland Light and Power agreed to provide information on the effectiveness of the power factor correction at the Humber Gardens, however they have not yet done so. Also complete monitoring data is not yet available for the pool blanket installed at the Windsor Commumity Pool.

5.3.3 Observations

Each of the projects seems to be controlling and managing energy consumption fairly well. These projects have demonstrated several very economically feasible technologies. This is reflected by the low payback periods on some projects. The maximum payback period of an energy management project was nine years.

Energy management and control simply regulate or reduce the amount of energy consumed by a building. Energy wasted from low power factors and from heating buildings at night can be greatly reduced by cutting power demand and consumption substantially.

Energy, Mines and
Resources Canada

Energie, Mines et
Ressources Canada

Mines & Energy
Newfoundland
& Labrador

Ventilation and Temperature Control
Wabush Recreation Centre

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Wabush, Labrador

Date:
August, 1985

Technology:
Energy Management
(Ventilation and
Temperature Control)

Project Manager:
Provincial Consultants Ltd.

Project Number:
03:03:38

Status:
Complete

Sector:
Recreational

Province:
Newfoundland

Purpose:

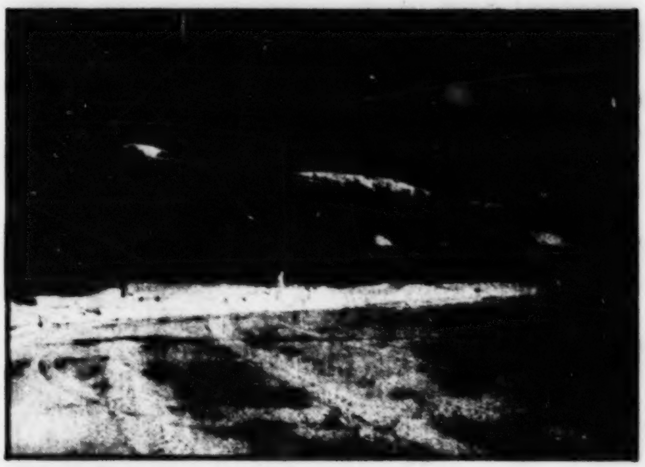
To demonstrate the application of night temperature setback and ventilation controls for reduced heating and ventilation during unoccupied periods, at a recreational centre.

Description:

Time clocks were installed to reduce ventilation operation during unoccupied periods. Temperature controls were installed to setback the night time space temperature by 5°C.

Contributors:

Wabush Town Council	$ 6,118
Canada/Newfoundland	$13,412
Total	$19,530



Wabush Recreation Centre.

Demonstrated Benefits/Savings:

A 12% reduction in energy cost is projected for the first year, for an annual saving of $7,000 or 17,500 L of oil.

Information Contact:

Provincial Consultants Ltd. or
3 Maxse Street
St. John's, Nfld.
A1C 2S6
Phone: (709) 726-6634

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone: (709) 576-2411

INDUSTRIAL/COMMERCIAL RETROFIT PROJECT

VENTILATION AND TEMPERATURE CONTROL

Economic Analysis:

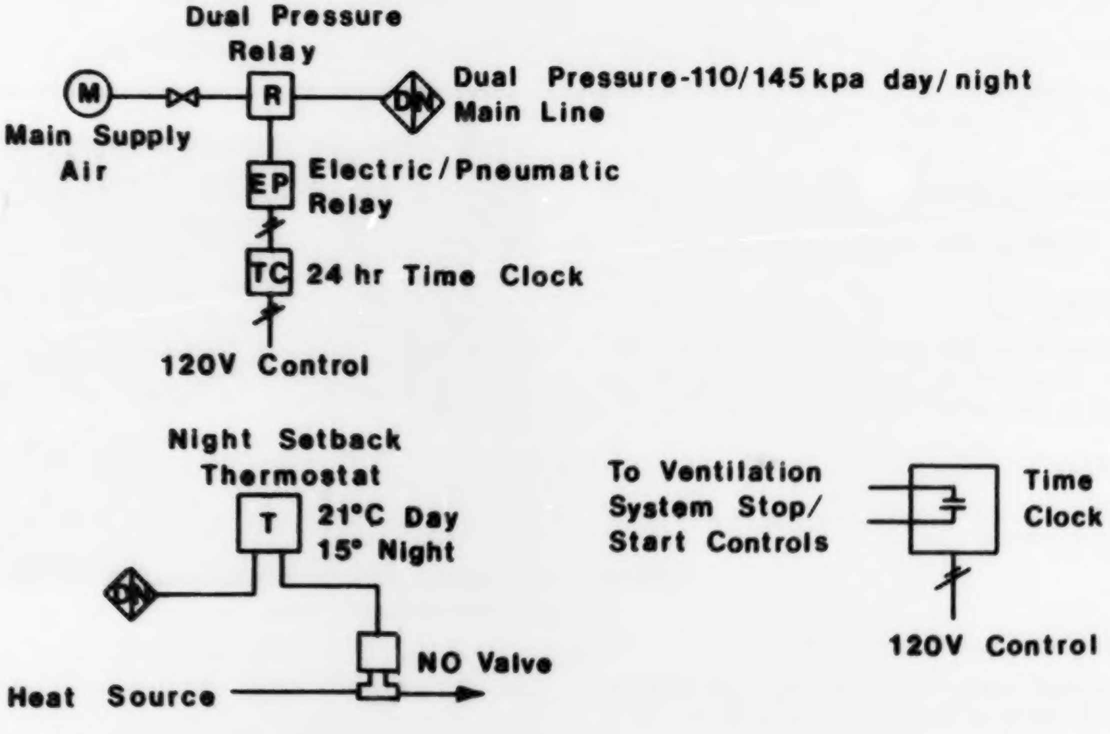
Materials	$ 6,430
Installation (plumbing, electrical and travel)	$12,100
Total Installed Cost	$18,530
Monitoring & Technology Transfer	$ 1,000
Total Demonstration Cost	$19,530
Operating Costs	
Pre Installation	$60,000
Post Installation	$53,000
Net Savings	$ 7,000
Simple Payback Period	2.6 years

Monitoring/Evaluation:

Annual fuel consumption records and building space temperatures are being recorded for a full calendar year after installation (March 1985).

Technical Details/Specifications

Pneumatic night setback thermostats are individually set for day and night temperatures, and activated by system pressure [(110 KPa (16 psi) day, 145 kPa (21 psi)] night. A time clock controls line pressure, and is programmed in accordance with the occupancy schedule. Ventilation time clocks turn systems off during unoccupied periods.


Dual Pressure Relay
M
R
D/N
Dual Pressure-110/145 kpa day/night Main Line
Main Supply Air
EP
Electric/Pneumatic Relay
TC
24 hr Time Clock
120V Control
Night Setback Thermostat
T
21°C Day 15° Night
D/N
NO Valve
Heat Source
To Ventilation System Stop/Start Controls
Time Clock
120V Control

NIGHT TEMPERATURE SETBACK CONTROL

VENTILATION CONTROL

Energy, Mines and Resources Canada
Energie, Mines et Ressources Canada

Mines & Energy
Government of Newfoundland
& Labrador

Swimming Pool Blanket
Exploits Swimming Pool

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

---

Project Location:
Windsor

Project Manager:
Exploits Swimming Pool Association

Date:
August, 1985

Project Number:

Status:
Complete

Technology:
Conservation
(Energy Management)

Sector:
Recreational (Pool)

Province:
Newfoundland

Purpose:

To demonstrate energy conservation by reducing heat and moisture loss from a 250 m^2 indoor swimming pool when not in use.

Description:

The blanket is a floating plastic cover 6.5 mm thick which covers the pool after pool operating hours. It reduces the evaporative heat loss from the surface of the pool thereby reducing the energy required to heat the pool water, and potential structural damage from condensation.

Contributors:

Exploits Swimming Pool Association	$3,300
Canada/Newfoundland	$6,500
Total	$9,800

Demonstrated Benefits/Savings:

A 5% reduction in energy cost is projected for the first year, for an annual saving of $2,000.

Part of the pool blanket deployed.

Information Contact:

M. Jacquie Embleton
Exploits Swimming Pool Association
P. O. Box 1151
Windsor, Nfld.
A0H 2H0
Phone: (709) 489-2991

or

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Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
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Phone: (709) 576-2411

SMALL SCALE PROJECT

SWIMMING POOL BLANKET

Economic Analysis:

Project Costs	
Materials	$9,700
Installation	$ 0
Total Installed Cost	$9,700
Monitoring and Technology Transfer	$ 100
Total Demonstration Savings	$9,800
Operating Costs	
Pre Installation	$42,000
Post Installation	$40,000
Net Savings	$ 2,000
Simple Payback Period	4.9 years

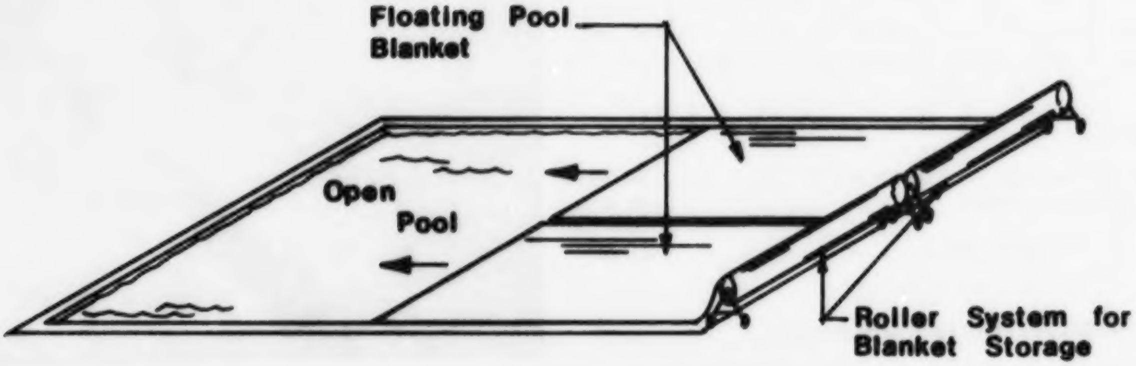
Monitoring Evaluation:

Electrical energy consumption was monitored from the monthly electricity bills.

Technical Details/Specifications:

The pool blanket is a plastic multilayer cover 6.5 mm thick which floats on the pool surface. It has two benefits (1) it reduces the evaporative heat loss from the pool, thereby cutting the energy cost to heat the water, and (2) the humidity in the pool complex is lowered which reduces the potential damage due to condensation in the building structural members. The blanket is mounted on roller stands which can be moved completely out of the vicinity of the pool apron during operation hours. Pool dimensions are 25 m by 10 m.

Schematic Diagram of Swimming Pool Blanket



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Energie, Mines et Ressources Canada

Mines & Energy
Government of
Newfoundland
& Labrador

Power Factor Improvement
Humber Gardens Arena

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Humber Gardens Arena
Corner Brook

Project Manager:
James Warford, P.Eng.
City of Corner Brook

Date:
March, 1985

Project Number:
03:04:222:46

Status:
Complete

Technology:
Power Factor Improvement

Sector:
Recreational (Ice Arena)

Province:
Newfoundland & Labrador

Purpose:

To demonstrate the electrical power demand reduction possible by the installation of capacitors on individual motors. The motors are located at a two rink ice arena facility in Corner Brook. The capacitors will reduce the reactive power drawn by the motors resulting in reduced building demand (kVA).

Description:

The brine circulation pump motor is 19 kW (25 HP) and the three refrigeration compressor motors are 22.3 kW (30HP), 37.3 kW (50 HP) and 44.8 kW (60 HP). Each of the four motors has a capacitor connected to the load side of its accompanying motor starter.

Contributors:

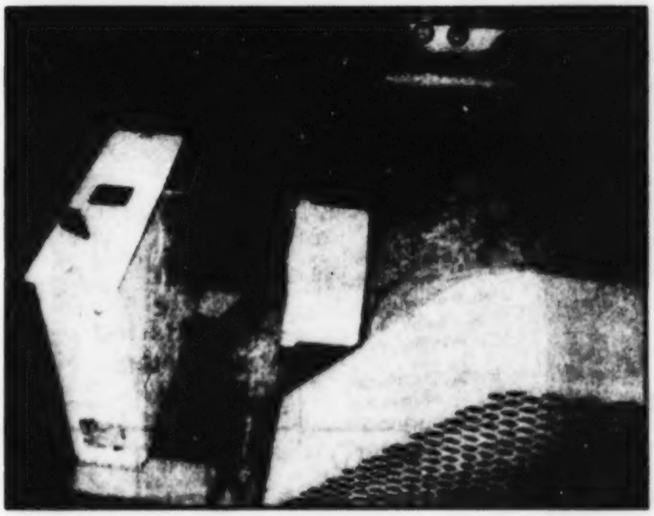
City of Corner Brook	$1,317
Canada/Newfoundland	$ 979
Total	$2,296

Information Contact:

Mr. J. Warford, P.Eng.
City of Corner Brook
P. O. Box 1080
Corner Brook, Newfoundland
A2H 6E1
(709) 634-8291

or

Information Section, Energy Branch
Department of Mines & Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
(709) 576-2411



A compressor pump with new capacitor installed.

Expected Benefits/Savings:

This project is expected to lower the demand by at least 6 kVA anually. However, monitoring results are not yet available.

SMALL SCALE PROJECT

POWER FACTOR IMPROVEMENT

Economic Analysis:

Project Costs

Capital	$1,130
Installation	$ 866
Total Installed Cost	$1,996
Monitoring & Technology Transfer	$ 300
Total Demonstration Cost	$2,296

Operating Costs

Pre Demonstration	$34,835
Post Demonstration (estimate)	$34,505
Net Savings (estimate)	$ 330
Simple Payback Period (estimate):	6.1 yrs.

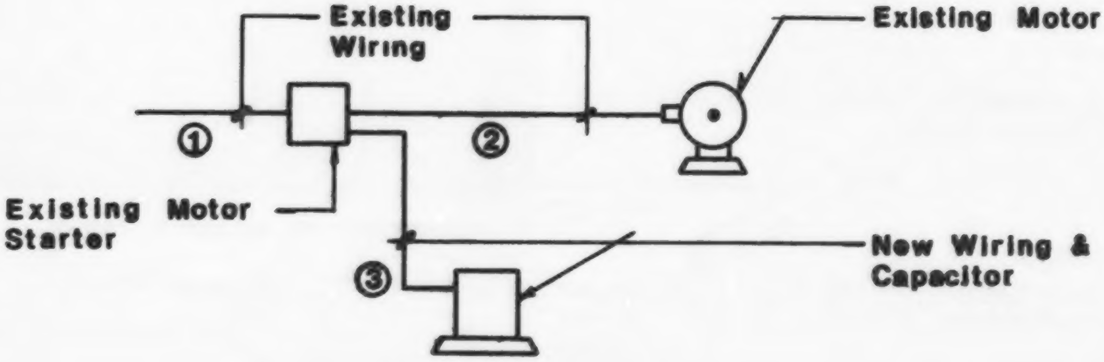
Monitoring Evaluation:

Items monitored were:
(1) monthly demand (kVA) and
(2) monthly consumption (kWh) from the utility billings to observe expected reductions due to the demonstration.

Technical Details/Specifications:

This project included the installation of a 600 V, 3 Phase, 60 Hz capacitor on each of four motors. For the 60 HP and 50 HP motors a 10 KVA capacitor, for the 30 HP motor a 7.5 KVA capacitor and for the 25 HP motor a 5kVA capacitor. Monitoring results are not yet available so that calculated reduction in the demand (kVA estimated before the project) was used.

Schematic Diagram of Motor Capacitor Installation



Energy, Mines and Resources Canada
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Mines & Energy
Newfoundland
& Labrador

Heat Recovery and Power Factor Correction

Hodder Memorial Stadium

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Deer Lake

Date:
August, 1985

Technology:
Conservation
(Heat Recovery)

Project Manager:
F. Wells
Plant Manager

Project Number:
03:04:22(2):38
Status:
Complete

Sector:
Recreational (Arenas)
Province:
Newfoundland

Purpose:

To demonstrate the energy savings possible in a 2,500m² ice arena, through the recovery of refrigerant compressor heat and power factor correction for motors.

Description:

Hot refrigerant gas is directed through desuperheat-plate jackets around large-capacity water heaters. The power factors of refrigeration system motors were improved by installing capacitors on them.

Contributors:

Town of Deer Lake	$ 5,049
Canada/Newfoundland	$10,901
Total	$15,950

Demonstrated Benefits/Savings:

The installation of these energy saving systems had reduced annual energy bills by $2,800 (7.8%)

Government of Newfoundland and Labrador
Energy Conservation Retrofit
A project under the
Renewable
Energy Demon
Program
Gouvernement de Terre Neuve et du Labrador
Améliorations en vue d'économiser l'energie
Programme de demonstration
des economies d'energie et
des energies renouvelables
Governme
of Canada
Gouvernement du Canada

The Egosaver heat exchanger tanks.

Information Contact:

F. Wells
Plant Manager
Town of Deer Lake
Box 940
Deer Lake, Nfld.
A0K 2E0
Phone (709) 635-2451

or

Information Section
Energy Branch
Dept. of Mines and Energy
P. O. Box 4750
St. John's, Nfld.
A1C 5T7
Phone (709) 576-2411

SMALL SCALE PROJECT

HEAT RECOVERY AND POWER FACTOR CORRECTION

Economic Analysis:

Project Costs

Labour	$ 9,350
Capital Cost	$ 5,500
Total Installed Cost	$14,850
Monitoring & Technology Transfer	$ 1,100
Total Demonstration Cost	$15,950

Operating Costs

Pre-Installation	$36,000
Post-Installation	$33,200
Net Savings	$ 2,800
Simple Payback Period	5.3 years

Monitoring/Evaluation

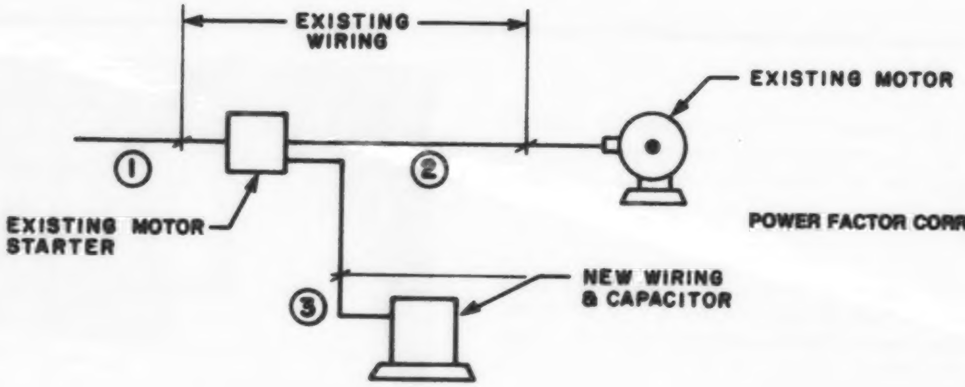
Items which are being monitored include:

(1) Egosaver output by BTU meter

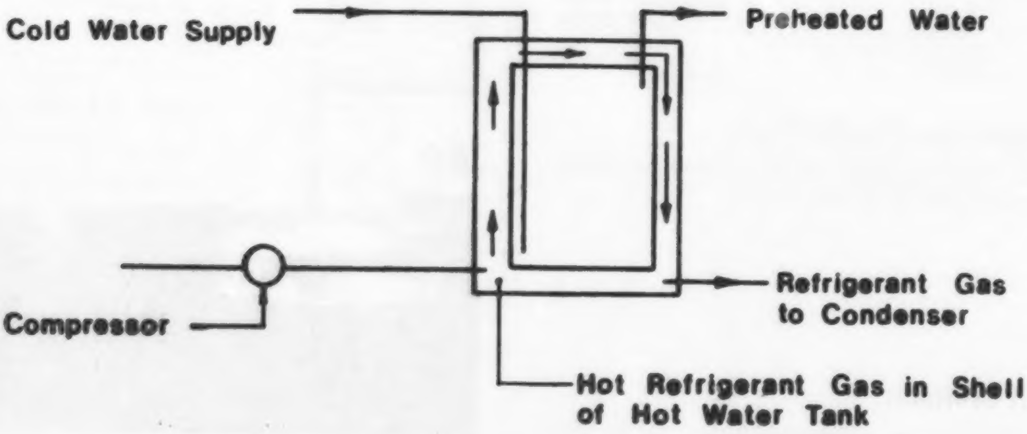
(2) Power factor correction by comparing utility bills kVA and kWh before and after installation of capacitors for one calendar year. The savings are based on three months' data.

Technical Details/Specifications:

An EA40 Egosaver heat exchanger was installed which removes heat from the hot gas in the refrigerant unit. This heat is used to preheat the cold water supply to two 450L domestic hot water tanks. Two 600V, 10 kVAR and one 600V, 5kVAR capacitors were installed on the compressors and brine pump motors to improve the power factors and thus lower the demand charges.


EXISTING WIRING
EXISTING MOTOR
①
②
EXISTING MOTOR STARTER
NEW WIRING & CAPACITOR
③

POWER FACTOR CORRECTION CAPACITO


Cold Water Supply
Preheated Water
Compressor
Refrigerant Gas to Condenser
Hot Refrigerant Gas in Shell of Hot Water Tank

HOT GAS HEAT RECOVERY SYSTEM

Energy, Mines and Resources Canada **Énergie, Mines et Ressources Canada** **Mines & Energy Newfoundland**

Energy Management System
Sir Wilfred Grenfell College
CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Sir Wilfred Grenfell College
Corner Brook, Newfoundland

Project Manager:
Mr. A. E. Kiernan
Dept. of University Works
Memorial University of Nfld.
St. John's, Newfoundland

Date:
November, 1983

Project Number:
03:04:22:30

Status:
Completed

Technology:
Conservation, Controls

Sector:
Institutional

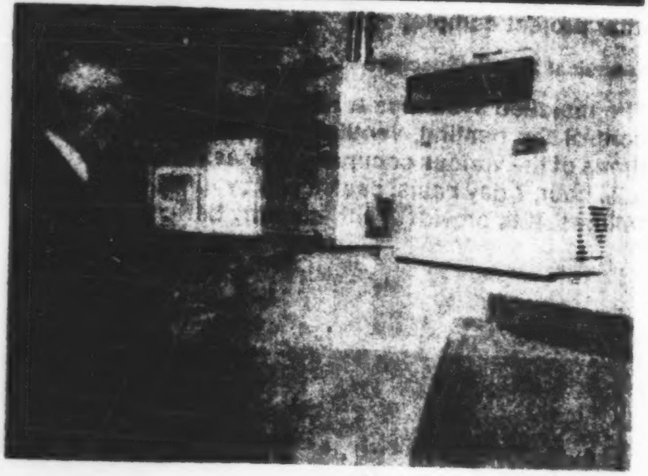
Province:
Newfoundland

Purpose:

To demonstrate the use of an energy management system to accommodate the needs of the multiple uses of the building.

Description:

The Sir Wilfred Grenfell College is a residential regional campus. It is an all electric building of approximately 17,250 m². The building contains besides the Academic and Administrative area, two residential wings, a cafeteria with full kitchen facilities, gymnasium and swimming pool all of which are provided with electric heating, ventilation and air conditioning systems. To save energy and decrease operating costs the energy management system with peak load control, load programmer and duty cycler was installed.



Contributors:

Project proponent	$26,578.00
Canada/Newfoundland	$10,000.00
Total	$36,578.00

Expected Benefits/Savings:

Energy consumption in 1981/82 was 18,000 GJ (5×10^6 kWh) with a billing demand of 1248 KVA. Energy costs were $181,710. Under present rates, a reduction in demand by 150 KVA would result in a savings of $6,750 a year. A reduction of 5% of the energy consumption of 900 GJ (2.5×10^5 kWh) will save an additional $10,000 for a total savings of $16,750 annually.

Further Information:

Report late 1983.

Information Contact:

Mr. A. E. Kiernan
Director of Operations Section
Department of University Works
Memorial University of Nfld.
St. John's, Newfoundland
A1B 3X7
Phone: (709) 737-8725

or

Energy Branch
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 737-2411

Project Name:

Energy Management System

Economic Analysis:

Total Installed Cost	$ 40,012
Total Demonstration Cost	1,000

Operating Cost:

Pre-demonstration annual fuel cost	$181,710
Post-demonstration annual fuel cost	164,960
Net annual fuel savings (150 KVA and 900 GJ (250,000 kWh))	16,750

Simple payback period: 2.5 years

Monitoring/Evaluation:

Monitoring will include recording peak load and total energy consumption on a monthly basis, down times, programming procedures and problems, and maintenance requirements. These records will be kept for two years after project completion.

Technical Details/Specifications:

The installed system is a Honeywell Microprocessor base load control system. The system is programmed to control the heating, ventilation and air conditioning systems according to the requirements and operational times of the various occupation areas. The system is capable of controlling up to 40 loads, cycle loads on and off a 24 hour, 7 day basis; peak loads by turning excessive loads off on a priority basis and indicate alarm in case of failures. It is provided with standby battery power when normal power fails.

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Mines & Energy Newfoundland

Instantaneous Domestic Hot Water Heaters

David Stewart

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Beach Road
Torbay, Newfoundland

Project Manager:
David Stewart
P. O. Box 10, Site 6
Torbay, Newfoundland
A0A 3Z0

Date:
April, 1983

Project Number:
03:04:22:05

Status:
Completed

Technology:
Energy Efficient Controls

Sector:
Residential

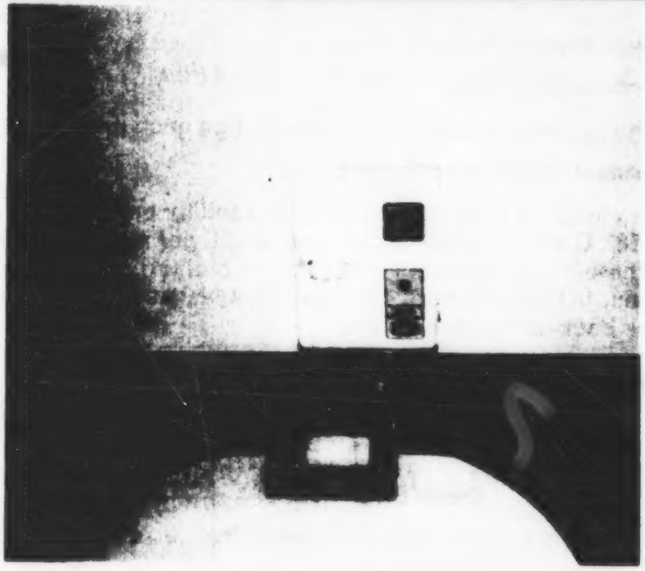
Province:
Newfoundland

Purpose:

To demonstrate the advantages of using small, tankless water heaters at point-of-use in place of a conventional domestic hot water tank.

Description:

Three electrical water heaters have been installed in the owner's low energy home. A Wilcox/Santon "Power Pack" is located in the kitchen and family bathroom while an "Electric Handwasher" model is installed in the ensuite bathroom. The system heats water only on demand.



Contributors:

Canada	(CREDA)	$389.00
Newfoundland	(CREDA)	97.00
David Stewart		486.00
	Total	$972.00

Demonstrated Benefits/Savings:

The owner anticipated a 56% reduction in electrical energy consumption from a conventional domestic hot water system which uses an average of 17.2 GJ (4,800 kwh) annually. Cost savings were expected to total $117.00. The owner actually achieved a 47% reduction in annual energy consumption, resulting in energy savings of 8.2 GJ (2,300 kwh) annually for actual cost savings of $103.00.

Further Information:

A summary report is available. A poster will be produced.

Information Contact:

David Stewart
Beach Road
Torbay, Newfoundland
Phone: (709) 437-6197

or Clarissa Dicks, Information Coordinator
Department of Mines and Energy
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
Phone: (709) 737-2411

SMALL SCALE PROJECT

Project Name:

Instantaneous Domestic Hot Water Heaters

Economic Analysis:

Project Costs:

Capital	$872.00
Installation	100.00
Total installed cost	$972.00
Monitoring	90.00
Total demonstration cost	$ 1,062.00

Operating Costs:

Pre-demonstration annual fuel cost (4800 kwh @ .046/kwh)	$220.00
Post-demonstration annual fuel cost (2544 kwh @ .046/kwh)	$117.00
Net annual fuel savings (2256 kwh @ .046/kwh)	$103.00
	9 years

Simple Payback Period: 9 years

Monitoring/Evaluation:

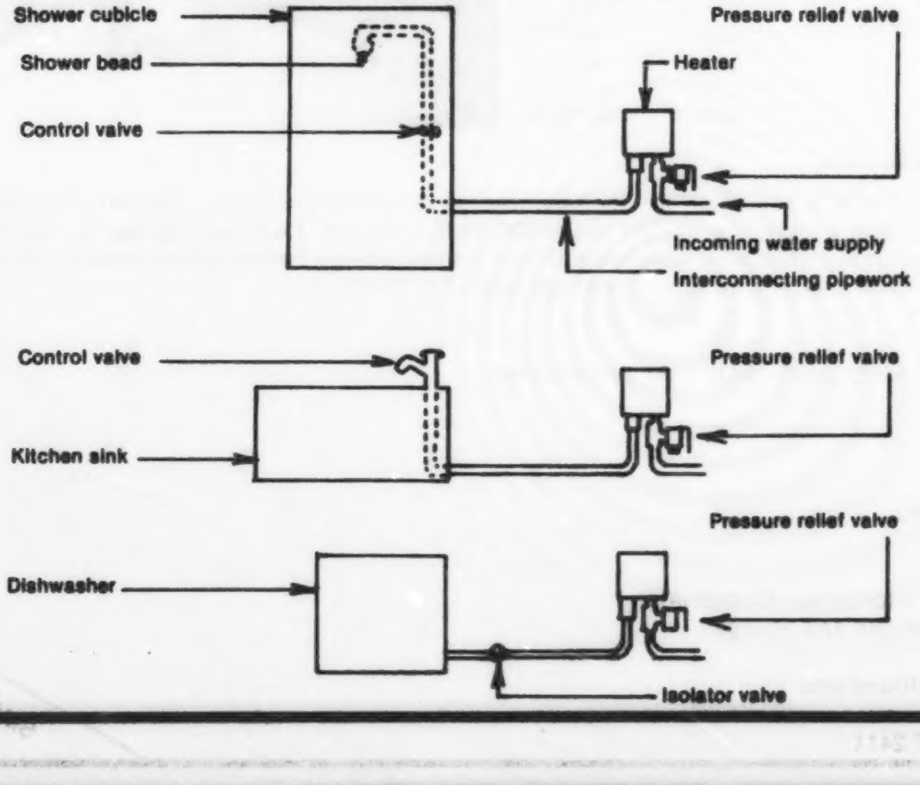
Running time meters will be installed on each unit to record actual hours of energy usage per unit.

Technical Details/Specifications:

The Wilcox/Santon "Power Pack" is used for both the sink and the dishwasher. It is capable of temperature rises of 58° C at a maximum flow rate of 5 L per minute. The same "Power Pack" has been installed in the family bathroom to provide hot water for the bathtub, shower and basin. The ensuite bathroom has the Wilcox/Santon "Electric Handwasher". This unit provides an 18 second flow of water at a preset temperature. There is no water tank back-up for these units.

Schematic Diagram:

DIAGRAM SHOWS HOOK UP OF WATER HEATERS FOR SHOWER CUBICLE, KITCHEN SINK AND DISHWASHER


Shower cubicle
Shower head
Control valve
Pressure relief valve
Heater
Incoming water supply
Interconnecting pipework
Control valve
Kitchen sink
Pressure relief valve
Pressure relief valve
Dishwasher
Isolator valve

5.3.3.1 Night Setback

The Wabush Recreation Centre, in Wabush, Labrador, has installed night setback devices to control night time temperatures. Time clocks also control the ventilation system. During the times the building is unoccupied, the ventilation system shuts down. This energy management system is operating very well and is saving the Wabush Recreation Centre $7,000 annually in fuel heating costs. This gives the project a payback period of 2.6 years.

From this demonstration it is clear that night setback controls have the potential for saving a great deal of money. A payback period of 2.6 years is very impressive and could be expected by other building owners who install night setback controls.

5.3.3.2 Pool Blankets

The Exploits Swimming Pool Association has installed a pool blanket at their community swimming pool in Windsor. The pool blanket is rolled out and then floats on the surface of the water. This has the effect of reducing the surface area of the pool and thereby greatly reduces the amount of evaporation from the pool.

Reducing the amount of evaporation from the pool has a twofold effect. Firstly, it reduces the amount of heat loss from the pool water to the air. Water vapour contains more energy than does liquid water, therefore the pool must release energy as water is evaporated from it. By reducing the amount of evaporation, heat loss from the pool is reduced. Secondly, by reducing the amount of evaporation from the pool the relative humidity of the pool room is lowered. This reduces the risk of potential damage, due to condensation, in the structural members of the building.

Unfortunately complete monitoring results are not yet available for this project, however estimates of annual fuel savings have been calculated. The Exploits Swimming Pool Association can expect to save $2,000 annually giving their project a payback period of 4.9 years.

Because of the potential reduction in energy costs, repairs and maintenance, pool blankets should be a standard piece of equipment for any swimming pool. Both community pools and large sports complexes should be able to benefit from owning and using pool blankets.

5.3.3.3 Power Factor Correction

There are two arenas which have power factor correction projects. One project is located at the Humber Gardens in Corner Brook. This stadium is a dual rink ice arena facility located in Corner Brook. There are four motors at this facility which are used for compression and circulation of the refrigerant medium. Because of the electrical characteristics of an induction motor more apparent power is used than real power. The ratio of real power to reactive power is called the power factor. By installing capacitors on each of the induction motors the amount of apparent power (the KVA demand) is reduced and the power factor is increased. The lower consumption of apparent power lowers the billing demand and therefore lowers the amount of money paid to the electrical utility company.

Newfoundland Light and Power had agreed to assess the success of the capacitor installation at the Humber Gardens but unfortunately this has not yet been done. There is no way of knowing exactly what benefit the capacitors have had on the power factor however, annual savings can be estimated. Approximately $330 annually should be saved on demand charges. From this approximation it is estimated that the payback period would be 7.1 years.

Hodder Memorial Stadium in Deer Lake has installed capacitors on each of three motors at its facility. This was part of a larger project which included a hot gas heat recovery system. Separate monitoring results from the power factor correction are not yet available.

5.3.3.4 Environmental Control

The Sir Wilfred Grenfell College in Corner Brook has installed a micro-processor controlled energy management system. This unit will control the heating, ventilation, and air conditioning systems on a 24 hour, seven day basis. The operation of these systems is reduced to a minimum whenever possible in an effort to reduce energy consumption. Also this unit will control the demand requirement of the college by operating different systems on a priority basis. This will prevent too many systems from operating at one time and therefore prevent unnecessary demand.

This system has proven to be very effective and is saving the College $16,750 annually. This savings gives the project a payback period of 2.5 years.

In larger buildings many environmental systems are operated unnecessarily. By regulating their use and avoiding similtaneous operation, energy consumption and building demands can be greatly reduced. Very considerable energy savings are possible in larger buildings. This should make any future government energy programs attractive to building operators.

5.3.3.5 Instantaneous Hot Water Heaters

Mr. D. Stewart had installed three instantaneous hot water heaters in his home. One heater was used for the shower, one for dishwasher, and another for a bathroom sink. The instantaneous heaters heat the water upon demand rather than heating the water and storing it in a tank. They are supposed to save money by reducing heat losses in the pipes and hot water tank. Since the three heaters were installed, two of them have been disconnected. The flow rates and the water temperatures were well below an acceptable level. The only one left installed is the one for the bathroom sink. The flow rate and water temperatures of this unit are acceptable for the purpose for which it is being used.

The energy savings from these devices is not great. A payback period of nine years can be expected by installing these devices. Perhaps in other parts of North America where supply water is not so cold, their operation would be more acceptable and feasible.

5.3.4 Cost/Benefit Analysis

Energy management and control has proven to be a very economically feasible and beneficial retrofit. Proper control of environmental systems and power factors leads to great savings in demand and consumption. Other such retrofits have shown energy savings and have produced acceptable investment returns.

5.3.4 Cost Benefit Analysis (Cont'd)

Most of these energy managing devices require installation involving construction so it would be cheaper to install these controls when initially constructing the building. However, if the expected payback period is low, it would be advisable for the building operator to install energy managing systems as soon as possible.

5.3.5 Conclusions

Most of the buildings which have installed energy management systems were large recreational centres. It is often the case that when these types of buildings were initially constructed insufficient attention was given to efficient energy utilization. Proper controls reduce wasting energy through such processes as heating and ventilating at night. Because there is no need to be billed for an unnecessarily low power factor or high demand, future demonstrations of this technology should be popular and successful.

Many other buildings benefit from the proper and efficient use of energy. Future government energy projects could be aimed at reducing the energy consumption of such places as community recreation centers, community service buildings, and other large buildings which consume large amounts of energy.

5.3.6 Recommendations

Because of the significant reductions in energy consumption and reactive power consumption possible through energy management and controls, it is recommended that the government setup future projects aimed specifically at larger buildings where communities or taxpayers must pay the bill for operating these centers. Savings of many thousands of dollars annually for each building is quite possible by efficiently managing and controlling energy consumption. Where payback periods are five years or less, it would be unwise to continue heating these buildings in an inefficient manner. The government and taxpayers would both benefit by reducing the energy consumption of these building.

The instantaneous domestic hot water heaters were not quite as successful as was anticipated. Because of the low flow rates and low water temperatures they would not be suitable for many domestic applications. They are, however, quite useful in an application such as a half bathroom where flow rates and water temperatures can be lower.

TABLE 6

ENERGY MANAGEMENT AND CONTROLS

PROPONENT	PROJECT COST	PAYBACK PERIOD	APPLICATION
Wabush Recreation Centre	$18,530	2.6 years	Night Setback
Windsor Pool	$ 9,700	4.9 years	Pool Blanket
Humber Gardens Power Factor	$ 1,996	*6.1 years	Power Factor Correction
Hodder Memorial Stadium	$14,850 **	5.3 years	Power Factor Correction
Sir Wilfred Grenfell College	$40,012	2.5 years	Environmental Control
D. Stewart	$ 972	9 years	Instantaneous Hot Water Heaters

* Estimated
** Includes Heat Recovery System

6.0 CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

Overall, the Small Scale Energy Demonstration Program ran successfully. The majority of the projects show very promising results for homeowners and small businesses. Some projects, however, were not so promising. Among the most promising projects were heat recovery systems, heat pumps, energy management systems, properly designed alternative energy devices, and waste fuel projects. Among the major disappointments were the propane car, sunspaces, and wind turbines.

It is interesting to note that the majority of proponents of the Small Scale projects were commercial rather than residential due to the generous financial incentives and full control of the progress of the retrofit implementation. Small business will take advantage of properly structured government incentive programs. However, one serious shortcoming was the lack of proper equipment installation and operation by some proponents which led to their eventual failure.

Newfoundland is a place where energy costs can be astronomical. There is a great possibility for homeowners and commercial users to reduce energy costs to a minimum. Proper care in the design of energy efficient devices and systems will help ensure a successful project and a favourable return on the investment.

6.1 Conclusions (Cont'd)

Some of the projects in this program suffered from poor design and project management while other projects showed excellence in both engeneering design and project management.

6.2 Monitoring

The monitoring results to date of many of the projects fall short of contract requirements. It is recognized that the monitoring of data is almost always imprecise for this type of program as most buildings did not offer ideal laboratory conditions. Nevertheless approximations of energy savings and equipment performance should be established for each project.

6.3 Recommendations

6.3.1 Government Implementations

There are three (3) main recommendations that come to light after having reviewed this program. They are:

(1) Because some of the technologies were so new, it was impossible for the proponents to properly design their system (as was demonstrated with the W.E.C.S.). In order to ensure successful operation of many of these new technologies, professional engineering advice should be sought.

6.3. Recommendations (Cont'd)

(2) A holdback of 10% to 20% of the funding until complete monitoring results have been obtained. This would have almost guaranteed proper monitoring as was required in the contracts.

(3) A final date should be set for project completion. By requiring projects to be completed by a final date, and not releasing funds until that time, perhaps Mr. Johnston's micro-hydro project, Mr. Robinson's chicken litter burner, and others would have been completed on time. It may also be wise to state on the contact that, except for extenuating circumstances, failure to complete the project on time could result in the proponent having to return any monies forwarded to them at the beginning of the project.

It is the feeling of the authors of this report that these recommendations would have resulted in some improved overall project results. The last two recommendations may have scared some people away from the project. However, the people deterred would most likely have been those people whose projects are presently incomplete due to lack of data or incomplete construction.

6.3.2 User Implications

There is only one recommendation which a potential user should keep in mind before proceeding with the implementation of these new technologies. This is to do proper research on the proposed energy conservation or renewable energy technology measure before committing funds. This means going to the appropriate government agencies such as Energy Mines and Resources Canada, the Newfoundland Department of Mines and Energy and the local utility. If the technology is very new, consider hiring a professional. He will be able to point out the advantages and disadvantages of each technology along with its potential dollar savings through reduced taxes, and available government assistance programs.

These new technologies offer the prospective user a great deal of savings in energy and money but not without a certain amount of additional work to make them work to their full value. Careful thought will always be required to use new technology.